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17th Sept
2020

NOTICE INVITING TENDER

(Document No PS:MSX:NIT)

Bharat Heavy Electricals Limited

Ref: BHEL/ NR/ SCT/ KHURJA/ STG/ UNIT#2 /1275
Date: 22/08/2022

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NOTICE INVITING E-TENDER (NIT)

NOTE: BIDDER MAY DOWNLOAD FROM WEB SITES

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To

Dear Sir/Madam

Sub : NOTICE INVITING E-TENDER

Sealed offers in two part bid system (National competitive bidding (NCB) are invited from reputed & experienced bidders (meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-1) 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/ NR/ SCT/ KHURJA/ STG/ UNIT#2 /1275***	
ii	**Broad Scope of job**	**ERECTION, TESTING, COMMISSIONING, TRIAL OPERATION AND HANDING OVER OF STEAM TURBINE, GENERATOR, INTEGRAL PIPING, 3x1500 KVA EMERGENCY DG SET, HP & LP PIPING AND OTHER AUXILIARIES OF THE SYSTEM INCLUDING BOIs etc. AND FINAL PAINTING OF THE UNIT INCLUDING SUPPLY OF PAINTS for Unit#2 AT 2X660 MW KHURJA STPP" U.P**	
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)*	*Applicable*
c	Volume-IC	*General Conditions of Contract (GCC)*	*Applicable*
d	Volume-ID	*Forms and Procedures*	
e	Volume-II	*Price Schedule (Absolute value).*	*Applicable*
iv	**Issue of Tender Documents**	**Tender documents will be available for downloading from BHEL eProcurement portal (*https://eprocurebhel.co.in)* till due date of submission:** ***Start : 22 /08/2022 , Time : 12:30 hrs*** ***Closes: 02/09/2022 , Time : 10:00 hrs*** Brief information of the tenders shall also be available at BHEL website (www.bhel.com)	*Applicable*
v	**DUE DATE & TIME OF OFFER SUBMISSION**	***Date : 02/09/2022, Time : 10:00 hrs*** ***Place : on https://eprocurebhel.co.in***	*Applicable*

vi	**OPENING OF TENDER**	***Date : 02/09/2022, Time : 15:30 hrs*** *Notes:* *(1) In case the due date of opening of tender becomes a non-working day, then the due date & time of offer submission and opening of tenders get extended to the next working day.* *(2) Bidder may depute representative to witness the opening of tender. For e-Tender, Bidder may witness the opening of tender through e-Procurement portal only.*	*Applicable*
vii	**EMD AMOUNT**	*Rs 28,81,988/-*	*Applicable*
viii	**COST OF TENDER**	*Free*	
ix	**LAST DATE FOR SEEKING CLARIFICATION**	***Five days before bid submission due date*** *Along with soft version also, addressing to undersigned & to others as per contact address given below:* *1) Name: Shabana Parveen* *Designation: Manager* *Deptt: SCT* *Address: BHEL-PSNR, PLOT NO. 25, SECTOR – 16A, NOIDA - 201301* *Phone: (Landline/Mobile) 0120 - 2416444* *Email : shabana.parveen@bhel.in* *2) Name: G.V.RAJASEKHAR* *Designation: Sr. Manager* *Deptt: SCT* *Address: BHEL-PSNR, PLOT NO. 25, SECTOR – 16A, NOIDA - 201301* *Phone: (Landline/Mobile) 0120-2416232* *Email : gvr@bhel.in*	*Applicable*
x	**SCHEDULE OF Pre Bid Discussion (PBD)**	*Date :*	*Not applicable.*
xi	**INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM)**	*Please refer clause no. 15.*	*Applicable*
xii	**Latest updates**	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc. to Tender Specifications will be hosted in BHEL webpage (www.bhel.com -->Tender Notifications →View Corrigendums), BHEL eProcurement portal (***https://eprocurebhel.co.in***) **and not in the newspapers**. Bidders to keep themselves updated with all such information.	

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 digitally using Class III DSC & uploaded in E-Procurement Portal, 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 **Not Used.**

4.0 Unless specifically stated otherwise, bidder shall deposit EMD as per clause 1.9 of General Conditions of Contract.

For Electronic Fund Transfer the details are as below-:

a) Name of the Beneficiary -: Bharat Heavy Electricals Limited

b) Bank Particulars

i).	Bank Name -:	STATE BANK OF INDIA
ii).	Bank Telephone No.(with STD code)-:	011-23475566
iii).	Branch Address-:	CAG II BRANCH, NEW DELHI 4th & 5th FLOOR, REDFORT CAPITAL, PARASNATH TOWERS, BHAI VEER SINGH MARG, GOLE MARKET, NEW DELHI-110001
iv).	Bank Fax No. (with STD code) -:	011-23475566
v).	Branch Code -:	17313
vi).	9 Digit MICR Code of the Bank Branch -:	110002562
vii).	Bank Account Number -:	10813608647
viii).	Bank Account Type -:	CASH CREDIT
ix).	11 Digit IFSC Code of Beneficiary Branch-:	SBIN0017313

(Note -: In case of E-Tenders, proof of remittance of EMD should be uploaded in the E-Procurement Portal and originals, as applicable, shall be sent to the officer inviting tender within a reasonable time, failing which the offer is liable to be rejected.)

5.0 **Procedure for Submission of Tenders**: This is an E-tender floated online through our E-Procurement Site (***https://eprocurebhel.co.in***). The bidder should respond by submitting their offer online only in our e-Procurement platform at (***https://eprocurebhel.co.in***)**.** Offers are invited in two-parts only.

Documents Comprising the e-Tender

The tender shall be submitted online ONLY EXCEPT EMD (in physical form) as mentioned below:

a. Technical Tender (UN priced Tender)

All Technical details (e.g. Eligibility Criteria requested (as mentioned below)) should be attached in e-tendering module, failing which the tender stands invalid & may be REJECTED. Bidders shall furnish the following information along with technical tender (preferably in pdf format):

- **i.** Earnest Money Deposit (EMD) furnished in accordance with NIT Clause 4.0. Alternatively, documentary evidence for claiming exemption as per clause 29 of NIT.
- **ii.** Technical Bid (without indicating any prices).

b. Price Bid:

i. Prices are to be quoted in the attached Price Bid format online on e-tender portal.
ii. The price should be quoted for the accounting unit indicated in the e-tender document.

iii. Note: It is the responsibility of tenderer to go through the Tender document to ensure furnishing all required documents in addition to above, if any. Any deviation would result in REJECTION of tender and would not be considered at a later stage at any cost by BHEL.

iv. A person signing (manually or digitally) the tender form or any documents forming part of the contract on behalf of another shall be deemed to warrantee that he has authority to bind such other persons and if, on enquiry, it appears that the persons so signing had no authority to do so, the purchaser may, without prejudice to other civil and criminal remedies, cancel the contract and hold the signatory liable for all cost and damages.

v. A tender, which does not fulfil any of the above requirements and/or gives evasive information/reply against any such requirement, shall be liable to be ignored and rejected.

DO NOT'S

Bidders are requested NOT to submit the hard copy of the Bid. In case offer is sent through hard copy/fax/telex/cable/electronically in place of e-tender, the same shall not be considered. **Also, uploading of the price bid in prequalification bid or technical bid may RESULT IN REJECTION of the tender**.

Digital Signing of e-Tender

Tenders shall be uploaded with all relevant PDF/zip format. The relevant tender documents should be uploaded by an authorized person having Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION digital signature certificate (DSC).

The Requirement:

1. A PC with Internet connectivity &
2. DSC (Digital Signature Certificate) (**Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION**)

The contact details of the service provider are given below:

For any technical related queries please call at 24 x 7 Help Desk Number

0120-4001 002, 0120-4001 005 & 0120-6277 787

International bidders are requested to prefix 91 as country code

Email Support - Technical - support-eproc@nic.in

Note: For any Issues or Clarifications relating to the published tenders, bidders are requested to contact the respective Tender Inviting Authority

The process of utilizing e-procurement necessitates usage of **DSC (Digital Signature Certificate) (Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION)** and you are requested to procure the same immediately, if not presently available with you. Please note that only with DSC, you will be able to login the e-procurement secured site and take part in the tendering process.

The contact details of the DSC Certifying Authority as given below:

Sl. No.	Name	Website Link
1	**GNFC**	www.ncodesolutions.com
2	**e-Mudhra**	http://www.e-Mudhra.com
3	**Safescrypt**	www.safescrypt.com

Vendors are also requested to go through seller manual available on ***https://eprocurebhel.co.in***.

6.0 Not used.

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:**

A. Bidder's 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 cut off month for reckoning 'Load' shall be the 3rd Month preceding the month corresponding to the 'latest date of bid submission', in the following manner -

(**Note:** For example, if latest bid submission is in Jan 2017, then the 'load' shall be calculated up to and inclusive of Oct 2016)

Total number of Packages in hand = Load (P)

Where 'P' is the sum of all unit wise identified packages (refer table-1) under execution with BHEL Regions as on the cut off month defined above, including packages yet to be commenced, excepting packages which are on Long Hold.

II. **PERFORMANCE**: Here 'Monthly Performance' of the bidder for all the packages (under execution/ executed during the 'Period of Assessment' in all 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 and including the cut off month. The cut off month for reckoning 'Period of Assessment' shall be the 3rd Month preceding the month corresponding to 'latest date of bid submission', in the following manner:

(**Note**: For example, if 'latest date of bid submission' is in Jan 2017, then the 'performance' shall be assessed for a 6 months' period up to and inclusive of Oct 2016 (i.e. from May 2016 to Oct 2016), 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 , …. P_N etc. be the packages (under execution/ executed during the 'Period of Assessment' in all Regions of BHEL) **SIMILAR** to the packages covered under the tendered scope, excepting packages not commenced. Total number of similar packages for all Regions = $\mathbf{P_T}$ (i.e. $P_T = P_1 + P_2 + P_3 + P_4 + \ldots P_N$)

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 ($S_{1\text{-}1}$, $S_{1\text{-}2}$, $S_{1\text{-}3}$, $S_{1\text{-}4}$, $S_{1\text{-}5}$…. $S_{1\text{-}T1}$) for similar package P_1, for the 'period of assessment' 'T_1' (i.e. $S_1 = S_{1\text{-}1} + S_{1\text{-}2} + S_{1\text{-}3} + S_{1\text{-}4} + S_{1\text{-}5} + \ldots S_{1\text{-}T1}$). 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_{BHEL}' for the Similar Package/Packages** (under execution/ executed during the 'Period of Assessment') in all the Power Sector Regions of BHEL

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

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

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 = $\mathbf{P_T}$ i.e. 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 Packages (as in row 1)	T_1	T_2	T_3	T_4	T_5	…	T_N	Sum (Σ) of columns (iii) to (ix) = $\mathbf{T_T}$
3	Monthly performance scores for the corresponding period (as in Row 2)	$S_{1\text{-}1}$, $S_{1\text{-}2}$, $S_{1\text{-}3}$, $S_{1\text{-}4}$, … $S_{1\text{-}T1}$	$S_{2\text{-}1}$, $S_{2\text{-}2}$, $S_{2\text{-}3}$, $S_{2\text{-}4}$, … $S_{2\text{-}T2}$	$S_{3\text{-}1}$, $S_{3\text{-}2}$, $S_{3\text{-}3}$, $S_{3\text{-}4}$, … $S_{3\text{-}T3}$	$S_{4\text{-}1}$, $S_{4\text{-}2}$, $S_{4\text{-}3}$, $S_{4\text{-}4}$, … $S_{4\text{-}T4}$	$S_{5\text{-}1}$, $S_{5\text{-}2}$, $S_{5\text{-}3}$, $S_{5\text{-}4}$, … $S_{5\text{-}T5}$	.. … … … …	$S_{N\text{-}1}$, $S_{N\text{-}2}$, $S_{N\text{-}3}$, $S_{N\text{-}4}$, … $S_{N\text{-}TN}$	--------

Sl. No.	Item Description	Details for all Regions							Total
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
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 at least 6 evaluation scores for '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' i.e. 6 months preceding and including the cut-off month
b) 12 months preceding and including the cut-off month
c) 24 months preceding and including 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

iv). Performance Systems: The performance rating as mentioned in II (i) and (ii) above, shall be calculated as per Online Systems i.e. Contractor Performance Evaluation System (CPES) and Safety Performance Evaluation System (HSEPES). The scores assigned in HSEPES shall be scaled down to 10 and assigned in CPES against the category "HSE" (mentioned in Form F-15).

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} ≥ 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 'I' above)

In addition to above, in case contractor fails to score more than 5 (five) marks in the scaled down scores of HSEPES for "more than 2 months in a period of 6 months preceding and including the cut-off month in any single package", the contractor shall be considered disqualified for ongoing tender(s) of BHEL. Qualification of bidder for further tendering process shall be subject to qualifying this condition in addition to qualifying requirements mentioned in PQR. Bidders who did not qualify this condition shall not be considered under the provisions of clause 9 IV (iv) of NIT.

IV. **Explanatory note**:

i). Similar package means Boiler or ESP or Piping or Turbine or Civil or Structure or Electrical or C&I 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, C&I, 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 (i.e. Boiler, ESP and Power Cycle Piping) and finally the Bidder's capacity to execute the tendered scope is assessed in line with III above.

ii). Identified Packages (Unit wise)

Table-1

Civil	Electrical and C&I	Mechanical
i). Enabling works ii). Pile and Pile Caps iii). Civil Works including foundations iv). Structural Steel Fabrication & Erection v). Chimney vi). Cooling Tower vii). Others (Civil)	i). Electrical ii). C&I iii). Others (Elect. and C&I)	i). Boiler & Aux (All types including CW Piping if applicable) ii). Power Cycle Piping/Critical Piping iii). ESP iv). LP Piping 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 Management x). FGD xi). ACC xii). Others (Mechanical)

iii). Bidders who have not been evaluated for at least six package months in the last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions, 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 completion of all the contracts against which vendor has been tagged as First Timer or availability of 6 evaluation scores within last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions.

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 'Assessment of Capacity of Bidders'.

iv). Consequent upon applying the criteria of 'Assessment of Capacity of Bidders' detailed above on all the bidders qualified against Technical and Financial Qualification criteria, if the number of qualified bidders reduces to less than four, then for further processing of the Tender, BHEL at its discretion reserves the right to also consider the bidders who are "not qualified" as per criteria of 'Assessment of Capacity of Bidders' and for this, procedure described in following three options shall be followed:

a) All the bidders having Overall Performance Rating ('R_{BHEL}') ≥60 shall be considered qualified against criteria of 'Assessment of Capacity of Bidders'.
b) If even after using option "a", the number of qualified bidders remains less than four, then in addition to bidders considered as per option "a", "First timer" bidders having average of available performance scores ≥60 upto and including the Cut Off month shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.
c) If even after using option "a" and "b", the number of qualified bidders remains less than four, then in addition to bidders considered as per option "a" and "b", "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.

Note:- In case, the number of bidders qualified against Technical and Financial Qualification criteria itself is less than four, then all bidders (a)- having Overall Performance Rating ('R_{BHEL}') ≥60, (b)- First timer" bidders having average of available performance scores ≥60 upto and including the Cut Off month, (c)- "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall be considered qualified against criteria of 'Assessment of Capacity of Bidders' for further processing of tender.

v). 'Under execution' shall mean works in progress as per the following:
a. Up to execution of 90% of anticipated Contract Value in case of Civil, MM, Structural and Turbo Blower Packages
b. Up to Steam Blowing in case of Boiler/ESP/Piping Packages
c. Up to Synchronization in all Balance Packages

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

vi). Contractor shall provide the latest contact details i.e. mail-ID and Correspondence Address to SCT Department, so that same can be entered in the Contractor Performance Evaluation System, and in case of any change/discrepancy same shall be informed immediately. Login Details for viewing scores in Contractor Performance Evaluation System shall be provided to the Contractor by SCT Department.

vii). Performance Evaluation for Activity Month shall be completed in Evaluation Month (i.e. month next to Activity Month) or in rare cases in Post Evaluation Month (i.e. month next to Evaluation Month) after approval from Competent Authority. In case scores are not acceptable, Contractor can submit Review Request to GM Site/ GM Project latest by 27th of Evaluation Month or 5 days after approval of score, whichever is later. However, acceptance/rejection of 'Review Request' solely depends on the discretion of GM Site/GM Project. After acceptance of Review Request, evaluation score shall be reviewed at site and the score after completion of review process shall be acceptable and binding on the contractor.

viii). Project on Hold due to reasons not attributable to bidder -

a. **Short hold:** Evaluation shall not be applicable for this period, however, Loading will be considered.

b. **Long hold:** Short hold for continuous six months and beyond or hold on account of Force Majeure shall be considered as Long Hold. Evaluation as well as Loading shall not be considered for this period.

ix). Performance evaluation as specified above in this clause 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 and/or through e-procurement portal, 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 of 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 Clause no. 1, Salient Features of NIT, Sl. no. (xi) above.**

"Integrity Pact (IP)"

(a) IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.

Sl. No.	IEM	Email
1.	Shri Otem Dai, IAS (Retd.)	iem1@bhel.in
2.	Shri Bishwamitra Pandey, IRAS (Retd.)	iem2@bhel.in
3.	Shri Mukesh Mittal, IRS (Retd.)	iem3@bhel.in

(b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/ three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

(c) Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEMs shall be done through email only.

Note:

No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department's officials whose contact details are as per Clause no. 1, Salient Features of NIT, Sl. No. (ix) 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-I (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 authorized 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) unless specified otherwise.

19.0 BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com on "**supplier registration page**") for this tender. RA shall be conducted among all the techno-commercially qualified bidders. Price Bids of all the techno-commercially qualified bidders shall be opened and same shall be considered as initial bids of bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking.

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 Consortium Bidding (or Technical Tie up) - **Not Applicable**

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

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

26.0 The consultant / firm (and any of its affiliates) shall not be eligible to participate in tender(s) for the related works or services for the same project, if they were engaged for the consultancy services.

27.0 Guidelines/rules in respect of Suspension of Business dealings, Vendor evaluation format, Quality, Safety & HSE guidelines, Experience Certificate, etc. may undergo change from time to time and the latest one shall be followed. The abridged version of extant 'Guidelines for suspension of business dealings with suppliers/ contractors' is available on www.bhel.com on "**supplier registration page**".

28.0 The offers of the bidders who are on the banned/ hold list and also the offer of the bidders, who engage the services of the banned/ hold firms, shall be rejected. The list of **banned/ hold firms** is available on BHEL web site www.bhel.com.

28.1 Integrity commitment, performance of the contract and punitive action thereof:

28.1.1 **Commitment by BHEL:**

BHEL commits to take all measures necessary to prevent corruption in connection with the tender Process and execution of the contract. BHEL will during the tender process treat all Bidder(s) in a transparent and fair manner, and with equity.

28.1.2 **Commitment by Bidder/ Supplier/ Contractor:**

(i) The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.

(ii) The bidder/ supplier/ contractor will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.

(iii) The bidder/ supplier/ contractor will perform/ execute the contract as per the contract terms & conditions and will not default without any reasonable cause, which causes loss of business/ money/ reputation, to BHEL.

If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage indulges in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the prices or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India, then, action may be taken against such bidder/ supplier/ contractor as per extent guidelines of the company available on www.bhel.com and / or under applicable legal provisions.

29.0 **Not Applicable**

30.0 The Bidder along with its associate/ collaborators/ sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website http://www.bhel.com and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice.

31.0 **PREFERENCE TO MAKE IN INDIA:**

For this procurement, the local content to categorize a supplier as a Class I local supplier/ Class II local Supplier/Non-Local Supplier and purchase preferences to Class I local supplier, is as defined in Public Procurement (Preference to Make in India), Order 2017 dated 04.06.2020 issued by DPIIT. In case of subsequent orders issued by the nodal ministry, changing the definition of local content for the items of the NIT, the same shall be applicable even if issued after issue of this NIT, but before opening of Part-II bids against this NIT.

31.1 **Compliance to Restrictions under Rule 144 (xi) of GFR 2017**

I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. The Competent Authority for the purpose of this Clause shall be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT).

II. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.

III. "Bidder from a country which shares a land border with India" for the purpose of this Clause means:-
   a. An entity incorporated established or registered in such a country; or
   b. A subsidiary of an entity incorporated established or registered in such a country; or
   c. An entity substantially controlled through entities incorporated, established or registered in such a country; or
   d. An entity whose *beneficial owner* is situated in such a country; or
   e. An Indian (or other) agent of such an entity; or
   f. A natural person who is a citizen of such a country; or
   g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above.

IV. The *beneficial owner* for the purpose of (III) above will be as under:
   1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.
      Explanation
      a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent of shares or capital or profits of the company.
      b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements.
   2. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership.
   3. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person has ownership of or entitlement to more than fifteen percent of the property or capital or profits of the such association or body of individuals.
   4. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
   5. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

V. An Agent is a person employed to do any act for another, or to represent another in dealings with third person.

VI. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

Note:

(i) The bidder shall provide undertaking for their compliance to this Clause, in the format provided in Annexure-11.

(ii) Registration of the bidder with Competent Authority should be valid at the time of submission of bids and at the time of acceptance of the bids.

32.0 **Not used**

33.0 In the course of evaluation, if more than one bidder happens to occupy L-1 status, effective L-1 will be decided by soliciting discounts from the respective L-1 bidders.

In case more than one bidder happens to occupy the L-1 status even after soliciting discounts, the L-1 bidder shall be decided by a toss/ draw of lots, in the presence of the respective L-1 bidder(s) or their representative(s).

Ranking will be done accordingly. BHEL's decision in such situations shall be final and binding.

34.0 The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.

35.0 **Not used**

36.0 Order of Precedence:

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

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

It may please be noted that guidelines/ circulars/ amendments/ govt. directives issued from time to time shall also be applicable.

for BHARAT HEAVY ELECTRICALS LTD
(SCT)

Enclosure:

(i) Annexure-1: Pre Qualifying Requirements.
(ii) Annexure-2: Check List.
(iii) Annexure-3: Not used
(iv) Annexure-4: Reverse Auction Process Compliance Form
(v) Annexure-5: Authorization of representative who will participate in the online Reverse Auction Process
(vi) Annexure-6: RA Price Confirmation and Breakup
(vii) Annexure-7: Integrity Pact
(viii) Annexure-8: Undertaking as per C4 of Annexure-1 i.e. PQR
(ix) Annexure-9: Declaration reg. Related Firms & their areas of Activities
(x) Annexure-10: Declaration reg. minimum local content in line with revised public procurement
(xi) Annexure-11: Declaration by the Contractor
(xii) Other Tender documents as per this NIT.

ANNEXURE - 1

PRE QUALIFYING REQUIREMENTS (PQR)

JOB	**ERECTION, TESTING, COMMISSIONING, TRIAL OPERATION AND HANDING OVER OF STEAM TURBINE, GENERATOR, INTEGRAL PIPING, 3x1500 KVA EMERGENCY DG SET, HP & LP PIPING AND OTHER AUXILIARIES OF THE SYSTEM INCLUDING BOIs etc. AND FINAL PAINTING OF THE UNIT INCLUDING SUPPLY OF PAINTS for Unit#2 AT 2X660 MW KHURJA STPP" U.P**
TENDER NO.	**BHEL/ NR/ SCT/ KHURJA/ STG/ UNIT#2 /1275**

SL. NO.	NAME AND DESCRIPTION OF PRE QUALIFICATION CRITERIA	
A	Submission of Integrity Pact	Applicable
B	**Technical** **Bidder who wish to participate should have experience as follows:** Bidder should have executed One STG or Boiler***** of ≥ 190 MW. **Note:** ***** Necessarily consisting of rotating machines	Applicable
C C-1	**FINANCIAL:** **TURNOVER:** Bidders must have achieved an average annual financial turnover (Audited) of **INR 565 Lacs or more** over last three Financial Years (FY) i.e. (2018-2019, 2019-2020, 2020-2021).	Applicable
C-2	**NET WORTH**: Net worth (only in case of companies) of the bidder should be positive. ***Note:*** *Net worth shall be calculated based on the latest Audited Accounts, as furnished for 'C-1' above.* *Net worth = Paid up share capital + Reserves.*	Applicable
C-3	**PROFIT:** Bidder must have earned profit in any one of the three financial years as applicable in the last three financial years as furnished for 'C-1' above based on latest Audited Accounts. ***Note:*** *PROFIT shall be PBT earned during any one year of last three financial years as in 'C-1' above.*	Applicable
C-4	Bidder must not be under Insolvency Resolution Process or Liquidation or Bankruptcy Code Proceedings (IBC) as on date, by NCLT or any adjudicating authority/authorities, which will render him ineligible for participation in this tender, and shall submit undertaking (Annexure-8) to this effect.	Applicable
D	Assessment of Capacity of bidder to execute the work as per clause 9.0 of NIT	Applicable – by BHEL
E	**Approval of Customer**	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*	By BHEL
G	**Consortium Criteria**	Not Applicable

Explanatory Notes for QR :

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. "Executed" means; (i) "SYNCHRONISATION" in respect of STG. (ii) "BOILER LIGHT UP" in respect of Boiler.

4. Boiler means HRSG or WHRB or any other types of Steam Generator.

5. For the purpose of evaluation of the PQR, one MW shall be considered equivalent to 3.5 TPH where ever rating of HRSG/BOILER is mentioned in MW.

6. "Executed" means the bidder should have achieved the technical criteria even if the contract has not been completed or closed.

7. Completion date for achievement of the technical criteria specified in the Technical' criteria of PQR (as in 'B' above) should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work. Completion date shall be reckoned from the "FY quarter of bid submission".

BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT INCLUSIVE OF WORK ORDER AND WORK COMPLETION CERTIFICATE ETC IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

Credentials submitted by the bidder against "PRE QUALIFYING CRITERIAS" shall be verified for its authenticity. In case, any credential (s) is/are found unauthentic, offer of the bidder is liable to the rejection. BHEL reserves the right to initiate any further action as per extant guidelines for Suspension of Business Dealings.

Format-1

Certificate for relationship between Parent Company / Subsidiary Company and the bidder

To,
…….

…….

Dear Sir,

Sub: Bid for NIT No ……..dated…… for "……." (name of the tender).

We hereby certify that M/s……..…… is Parent Company/ Subsidiary Company of M/s ……(the bidder) and details of equity holding of the Parent Company in Subsidiary Company as on ……..(not earlier than seven days prior to the Bid Submission Date) are given as below:

Name of Parent Company	Name of Subsidiary Company	Percentage of Equity Holding of Parent Company in Subsidiary Company

(Insert Name and Signature of Statutory Auditor or practicing Company Secretary of the Bidder)

Format-2

Undertaking from the Parent Company/ Subsidiary Company of the bidder

(On the Letter Head of Parent Company/ Subsidiary Company, as applicable)

From,
Name:
Full Address:

Telephone No.:
E-mail address:
Fax/No.:

To,
……..
……..

Dear Sir,

We refer to the NIT No .....dated…… for "……." (name of the Tender).

"We have carefully read and examined in detail the NIT/Tender Terms and Conditions, including in particular, Clause .... of the NIT/Tender, regarding submission of an Undertaking, as per the prescribed Format 1 of the NIT/ Tender.

We confirm that M/s…… (the Bidder) has been authorized by us to use our Technical capability for meeting the Technical Criteria as specified in Clause……..of the PQR of the NIT/Tender referred above.

We agree to submit the Security Deposit equivalent to 1% of the total contract value in addition to Security Deposit to be submitted by Bidder as per Clause…….....of the NIT/Tender for fulfilment of all obligations in terms of provisions of the contract, in the event of ……..(the Bidder) being selected as the Successful Bidder.

We confirm that we along with M/s……(the bidder), are jointly or severally responsible for successful performance of the contract.
We confirm that our company shall not participate in the above tender as a 'Standalone Bidder' or as a 'Consortium bidder' and also shall not authorize any other bidder to use our Technical capability for the above tender.

All the terms used herein but not defined, shall have the meaning as ascribed to the said terms under the referred NIT/Tender.

Signature of Managing Director/Authorized signatory of Parent/ Subsidiary Company

ANNEXURE - 2

CHECK LIST

NOTE:- Tenderers are required to fill in the following details and no column should be left blank

1	**Name of the Tenderer**	
2	**Address of the Tenderer**	
3	**Type of the Firm/ Company**	
(i)	In case of Individual Tenderer	His / her full name, address and place & nature of business shall be furnished along with the offer.
(ii)	In case of Partnership Firm	The names of all the partners and their addresses, A copy of the partnership deed/instrument of partnership dully certified by the Notary Public shall be furnished along with the offer..
(iii)	In case of Companies	a) Date and place of registration including date of commencement certificate in case of Public Companies (certified copies of Memorandum and articles of Association are also to be furnished). b) Nature of business carried on by the Company and the provisions of the Memorandum relating thereof.
4.a	**Details of Contact person for this Tender**	Name : Mr/ Ms Designation: Telephone No: Mobile No: Email ID:
4.b	**Details of alternate Contact person for this Tender**	Name : Mr/ Ms Designation: Telephone No: Mobile No: Email ID:
5	**EMD DETAILS**	
6	**Validity of Offer**	TO BE VALID FOR **SIX MONTHS** FROM DUE DATE

	DESCRIPTION	**APPLICABILITY (BY BHEL)**	**ENCLOSED BY BIDDER**
7	Whether all pages of the Tender documents including annexures, appendices etc are read and understood	Applicable	YES / NO
8	Whether the format for compliance with **PRE QUALIFICATION CRITERIA** (ANNEXURE – 1) is understood and filled with proper supporting documents referenced in the specified format	Applicable	YES / NO
9	Audited Balance Sheet and profit & Loss Account for the last three years	Applicable	YES / NO
10	Copy of PAN Card	Applicable	YES / NO
11	Copy of GST registration	Applicable	YES / NO

SL. NO.	DESCRIPTION	APPLICABILITY (BY BHEL)	ENCLOSED BY BIDDER
12	Organization Chart of the tenderer's organization, including the names, addresses and contact information of the Directors/Partners shall be furnished along with the offer.	Applicable	YES / NO
13	Integrity Pact (Annexure – 7 of NIT)	Applicable	YES / NO
14	Annexures – 5, 8, 9, 10 & 11 of NIT	Applicable	YES / NO
15	Offer forwarding letter / tender submission letter ***[Form No. F-01 (Rev 00)]***	Applicable	YES / NO
16	Declaration by Authorised Signatory ***[Form No: F-02 (Rev 00)]***	Applicable	YES / NO
17	Declaration by Authorised Signatory regarding Authenticity of submitted documents ***[Form No: F-02A (Rev 00)]***	Applicable	YES / NO
18	No Deviation Certificate ***[Form No: F-03 (Rev 00)]***	Applicable	YES / NO
19	Declaration confirming knowledge about Site Conditions ***[Form No: F-04 (Rev 00)]***	Applicable	YES / NO
20	Declaration for relation in BHEL ***[Form No: F-05 (Rev 00)]***	Applicable	YES / NO
21	Non-Disclosure Certificate ***[Form No: F-06 (Rev 00)]***	Applicable	YES / NO
22	Bank Account Details for E-Payment ***[Form No: F-07 (Rev 00)]***	Applicable	YES / NO
23	Format for seeking clarification ***[Form No: F-08 (Rev 00)]***	Applicable	YES / NO
24	Capacity Evaluation of Bidder for current Tender ***[Form No: F-09 (Rev 00)]***	Applicable	YES / NO
25	Power of Attorney for Submission of Tender/Signing Contract Agreement ***[Form No: F-25 (Rev 00)]***	Applicable	YES / NO
26	Analysis of Unit rates ***[Form No: F-26 (Rev 00)]***	Applicable	YES / NO

NOTE : STRIKE OFF 'YES' OR 'NO', AS APPLICABLE. TENDER NOT ACCOMPANIED BY THE PRESCRIBED **ABOVE APPLICABLE DOCUMENTS** ARE LIABLE TO BE SUMMARILY REJECTED.

DATE :

Sign. of the AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

ANNEXURE – 3
Not used

ANNEXURE - 4

Reverse Auction Process Compliance Form

(The bidders are required to print this on their company's letterhead and sign, stamp before RA)

To

- M/s. {*Service provider*
- *Postal address}*

Sub: Agreement to the Process related Terms and Conditions

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the RFQ document for {Items} against BHEL enquiry/ RFQ no.{……} dt. {…….}
This letter is to confirm that:

1) The undersigned is authorized official/ representative of the company to participate in RA and to sign the related documents.
2) We have studied the Reverse Auction guidelines (as available on www.bhel.com), and the Business rules governing the Reverse Auction as mentioned in your letter and confirm our agreement to them.
3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
4) We also confirm that, in case we become L1 bidder, we will FAX/ email the price confirmation & break up of our quoted price as per *Annexure - 6* within **two** working days (of BHEL) after completion of RA event, besides sending the same by registered post/ courier both to M/s. BHEL and M/s. {*Service provider.}*

We, hereby confirm that we will honor the Bids placed by us during the auction process.

With regards

Signature with company seal

Name:
Company / Organization:
Designation within Company / Organization:
Address of Company / Organization:

Sign this document and FAX/ email it to M/s *{Service provider}* at *{……..}* prior to start of the Event.

ANNEXURE – 5

Authorization of representative who will participate in the on line Reverse Auction Process:

1	NAME OF THE BIDDER	
2	NAME & DESIGNATION OF OFFICIAL	
3	POSTAL ADDRESS (COMPLETE)	
4	TELEPHONE NOS. (LAND LINE & MOBILE BOTH)	
5	E-MAIL ADDRESS	
6	NAME OF PLACE/ STATE/ COUNTRY, WHEREFROM S/HE WILL PARTICIPATE IN THE REVERSE AUCTION	

ANNEXURE – 6

RA price confirmation and breakup
(To be submitted by L1 bidder after completion of RA)

To
- M/s. *Service provider*
- *Postal address*

CC: M/s BHEL
{Unit-
Address-}
Sub: **Final price quoted during Reverse Auction and price breakup**

Dear Sir,

We confirm that we have quoted.

Rs.{____in value & in words_____} for item(s) covered under tender enquiry No. {...} dt.{…}

Total price of the items covered under above cited enquiries is inclusive of {*Packing & forwarding, GST, E.D., C.S.T., freight and insurance charges up to {……} District,{……..} State and Type Test Charges etc., (exclusive of service tax)*, *other as per NIT*}

as our final landed prices as quoted during the Reverse Auction conducted today {*date*} which will be valid for a period of {___ **in nos. & in words** ___} days.

The price break-up is as given below.

========
Total - Rs. **in value & in words**
========

Yours sincerely,

For _____

Name:
Company:
Date:
Seal:

ANNEXURE – 7

INTEGRITY PACT

Integrity Pact format attached separately

ANNEXURE – 8

UNDERTAKING

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir/Madam,

Sub: DECLARATION REGARDING INSOLVENCY/ LIQUIDATION/ BANKRUPTCY PROCEEDINGS

Ref: NIT/Tender Specification No:

I/We, _____

declare that, I/We am/are not under insolvency resolution process or liquidation or Bankruptcy Code Proceedings (IBC) as on date, by NCLT or any adjudicating authority/authorities, which will render us ineligible for participation in this tender.

Sign. of the AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Place:
Date:

ANNEXURE-9

DECLARATION

Date: _____

To: _____
Address: BHEL,_____
_____
_____
_____
Email: _____

Sub: **Details of related firms and their area of activities**

Dear Sir/ Madam,

Please find below details of firms owned by our family members that are doing business/ registered for same item with BHEL, _____ (NA, *if not applicable*)

1	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
2	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
…		

Note: I certify that the above information is true and I agree for penal action from BHEL in case any of the above information furnished is found to be false.

Regards,

(_____)

From: M/s _____
Supplier Code: _____
Address: _____
_____
_____

Annexure-10

DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04TH JUNE, 2020 AND SUBSEQUENT ORDER(S)

(To be typed and submitted in the Letter Head of the Entity/Firm providing certificate as applicable)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04th June, 2020 and subsequent order(s).

Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

We hereby certify that the items/works/services offered by…… *(specify the name of the organization here)* has a local content of _____ % and this meets the local content requirement for **'Class-I local supplier' / 'Class II local supplier' **** as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

The details of the location(s) at which the local value addition is made are as follows:

1. _____ 2. _____

3. _____ 4. _____

…
…
…

Thanking you,
Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

****** - *Strike out whichever is not applicable.*

Note:

1. Bidders to note that above format Duly filled & signed by authorized signatory, shall be submitted along with the techno-commercial offer.
2. In case the bidder's quoted value is in excess of Rs. 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practising cost accountant or practicing chartered accountant (in respect of suppliers other than companies).
3. In the event of false declaration, actions as per the above order and as per BHEL Guidelines shall be initiated against the bidder.

ANNEXURE-11

DECLARATION REGARDING COMPLIANCE TO RESTRICTIONS UNDER RULE 144 (xi) OF GFR 2017

(To be typed and submitted in the Letter Head of the Entity/ Firm providing certificate as applicable)

To,
(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Declaration regarding compliance to Restrictions under Rule 144 (xi) of GFR 2017

Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries. I certify that _____ (**SPECIFY THE NAME OF THE ORGANIZATION HERE**), is not from such a country/ has been registered with the Competent Authority (*attach valid registration by the Competent Authority, i.e., the Registration Committee constituted by the Dept. for Promotion of Industry and Internal Trade (DPIIT*); and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. (*attach relevant valid registration, if applicable*)

I hereby certify that we fulfil all requirements in this regard and is eligible to be considered.

Thanking you,
Yours faithfully,

(Signature, Date & Seal of
Authorized Signatory of the Bidder)

Note: Bidders to note that in case above certification given by a bidder, whose bid is accepted, is found to be false, then this would be a ground for immediate termination and for taking further action in accordance with law and as per BHEL guidelines.

Annexure-1

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for Erection, Testing, Commissioning, trial operation & Handing over of steam, Turbine, Generator, Integral piping, 3 x 1500KVA Emergency DG set, HP & LP piping & other Auxiliaries of the system including BOIs etc. & final painting of the unit including supply of paints for unit-2 at 2 x 660 MW Khuja ~~STPP~~ (hereinafter referred to as "Contract"). The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint panel of Independent External Monitor(s) (IEMs), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles: -

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 - Commitments of the Bidder(s)/ Contractor(s)

2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. The Bidder(s)/ Contractor(s) commits himself to observe the following principles during participation in the tender process and during the contract execution.

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2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and shall await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process , terminate the contract, if already awarded, exclude from future business dealings and/ or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

4.1 If the Principal has disqualified the Bidder (s) from the tender process before award / order acceptance according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.

4.2 If the Principal is entitled to terminate the Contract according to Section 3, or terminates the Contract in application of Section 3 above , the Bidder(s)/ Cotractor (s) transgression through a violation of Section 2 above shall be construed breach of contract and the Principal shall be-entitled to demand and recover from the Contractor an amount equal to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee , whichever is higher, as damages, in addition to and without prejudice to its right to demand and recover compensation for any other loss or damages specified elsewhere in the contract.

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Section 5 - Previous Transgression

5.1 The Bidder declares that no previous transgressions occurred in the last 3 (three) years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason or action can be taken as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 6 - Equal treatment of all Bidder (s)/ Contractor (s) / Sub-contractor (s)

6.1 The Principal will enter into Integrity Pacts with identical conditions as this Integrity Pact with all Bidders and Contractors.

6.2 In case of Sub-contracting, the Principal Contractor shall take the responsibility of the adoption of Integrity Pact by the Sub-contractor(s) and ensure that all Sub-contractors also sign the Integrity Pact.

6.3 The Principal will disqualify from the tender process all Bidders who do not sign this Integrity Pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 -Independent External Monitor(s)

8.1 The Principal appoints competent and credible panel of Independent External Monitor (s) (IEMs) for this Integrity Pact. The task of the IEMs is to review independently and objectively, whether and to what extent the parties comply with the obligations under this Integrity Pact.

8.2 The IEMs are not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.

8.3 The IEMs shall be provided access to all documents/ records pertaining to the Contract, for which a complaint or issue is raised before them as and when warranted. However, the documents/records/information having National Security implications and those documents which have been classified as Secret/Top Secret are not to be disclosed.

8.4 The Principal will provide to the IEMs sufficient information about all meetings among the parties related to the Contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the IEMs the option to participate in such meetings.

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8.5 The advisory role of IEMs is envisaged as that of a friend, philosopher and guide. The advice of IEMs would not be legally binding and it is restricted to resolving issues raised by a Bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some Bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.

8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process or during execution of Contract, the matter should be examined by the full panel of IEMs jointly, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.

8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to the CMD, BHEL at the earliest. They may also send their report directly to the CVO, in case of suspicion of serious irregularities requiring legal/ administrative action. Only in case of very serious issue having a specific, verifiable Vigilance angle, the matter should be reported directly to the Commission. IEMs will tender their advice on the complaints within 30 days.

8.8 The CMD, BHEL shall decide the compensation to be paid to the IEMs and its terms and conditions.

8.9 IEMs should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the Prinicpal should be looked into by the CVO of the Principal.

8.10 If the IEMs have reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code / Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the IEMs may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.11 After award of work, the IEMs shall look into any issue relating to execution of Contract, if specifically raised before them. As an illustrative example, if a Contractor who has been awarded the Contract, during the execution of Contract, raises issue of delayed payment etc. before the IEMs, the same shall be examined by the panel of IEMs. Issues like warranty/ guarantee etc. shall be outside the purview of IEMs.

8.12 However, the IEMs may suggest systemic improvements to the management of the Principal, if considered necessary, to bring about transparency, equity and fairness in the system of procurement.

8.13 The word `Monitor' would include both singular and plural.

Section 9 - Pact Duration

9.1 This Integrity Pact shall be operative from the date this Integrity Pact is signed by both the parties till the final completion of contract for successful Bidder, and for all other Bidders 6 months after the Contract has been awarded. Any violation of the same would entail disqualification of the bidders and exclusion from future business dealings.

9.2 If any claim is made/ lodged during currency of this Integrity Pact, the same shall be binding and continue to be valid despite the lapse of this Pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

10.1 This Integrity Pact is subject to Indian Laws and exclusive jurisdiction shall be of the competent Courts as indicated in the Tender or Contract, as the case may be.

10.2 Changes and supplements as well as termination notices need to be made in writing.

10.3 If the Bidder(s)/ Contractor(s) is a partnership or a consortium or a joint venture, this Integrity Pact shall be signed by all partners of the partnership or joint venture or all consortium members.

10.4 Should one or several provisions of this Integrity Pact turn out to be invalid, the remainder of this Integrity Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders / contractors who have entered into this Integrity Pact with the Principal would be competent to participate in the bidding. In other words, entering into this Integrity Pact would be a preliminary qualification.

10.6 In the event of any dispute between the Principal and Bidder(s)/ Contractor(s) relating to the Contract, in case, both the parties are agreeable, they may try to settle dispute through Mediation before the panel of IEMs in a time bound manner. In case, the dispute remains unresolved even after mediation by the panel of IEMs, either party may take further action as the terms & conditions of the Contract. The fees/expenses on dispute resolution through mediation shall be shared by both the parties. Further, the mediation proceedings shall be confidential in nature and the parties shall keep confidential all matters relating to the mediation proceedings including any settlement agreement arrived at between the parties as outcome of mediation. Any views expressed, suggestions, admissions or proposals etc. made by either party in the course of mediation shall not be relied upon or introduced as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the dispute that is the subject of mediation proceedings. Neither of the parties shall present IEMs as witness in any Alternative Dispute Resolution or judicial proceedings in respect of the dispute that was subject of mediation.

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Shabana Parveen
Manager/ S&T

For & On behalf of the Principal
(Office Seal)

Place Noida
Date 22/08/2022

For & On behalf of the Bidder/ Contractor
(Office Seal)

Witness:_____
(Name & Address) _____
_____

Witness:_____
(Name & Address) _____
_____

TECHNICAL CONDITIONS OF CONTRACT

FOR

"ERECTION, TESTING, COMMISSIONING, TRIAL OPERATION AND HANDING OVER OF STEAM TURBINE, GENERATOR, INTEGRAL PIPING, 3x1500 KVA EMERGENCY DG SET, HP & LP PIPING AND OTHER AUXILIARIES OF THE SYSTEM INCLUDING BOIs etc. AND FINAL PAINTING OF THE UNIT INCLUDING SUPPLY OF PAINTS for Unit#2 AT 2X660 MW KHURJA STPP" U. P

AT

2X660 MW KHURJA SUPER THERMAL POWER PROJECT, KHURJA, BULANDSHAHAR, U.P.

Bharat Heavy Electricals Limited
(A Govt. Of India Undertaking)
Power Sector – Northren Region,
Plot No. 25 , Sector - 16A,
Distt. Gautam Buddh Nagar,
NOIDA – 201 301 (INDIA)

TECHNICAL CONDITIONS OF CONTRACT (TCC)
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2X660MW KHURJA STPP- STG PACKAGE

THDC, a joint venture of Government of India & Government of UP, has awarded the work to BHEL for supply, erection and commissioning of "Turbine Generator and Associated packages" for 2x660MW Khurja STPP at Khurja, U.P.

Sl. No.	Title	Description
1	**Owner**	**THDC India Limited (THDCIL)**
2	**Consultant**	NTPC Limited
3	**Project Title**	Khurja Super Thermal Power Project (2X660 MW)
4	**Project Site Location**	Khurja STPP is located in Bulandshahar district of Uttar Pradesh. The site is situated near villages Dushhara-kherli, Jahanpur, Naiphal (Unchagaon) and Rukunpur. The district Headquarters Bulandshahar is about 32Kms. Distance of the project site from Delhi is about 90Kms.
5	**Nearest Railway Station**	The nearest railway station Danwar on Delhi-Kolkata section (via Aligarh) is approx. 5Km away from the project site. The nearest major railway station is Khurja at a distance of about 11kms.
6	**Nearest Airport**	The nearest commercial airport is Delhi at about 120 km by road
7	**Nearest Highway**	NH34
8	**Nearest Water Body**	The upper Ganga canal passes near by the Khurja STPP at a distance of about 13 Kms
9	**Seismic Data**	The area falls in Zone III (Moderate), according to the Indian Standard Seismic Zoning Map

Note: - The bidder is advised to visit and examine the site and its surroundings and obtain for himself on his own responsibility all information that may be necessary for preparing the bid and entering into the CONTRACT. All costs for and associated with site visits shall be borne by the bidder.

2.0 SCOPE OF WORK

BHEL has been awarded the work of "Design, Engineering, Supply, Erection, Testing & Commissioning of Turbine Generator, associated packages and HP & LP Piping" for 2x660MW Khurja STPP at Khurja, U.P by THDC India Limited (THDCIL). This contract deals with scope of work of TG package **unit No. 2, as detailed in the tender below.**

Scope of work under this tender specification consists of receipt, loading, handling and collection of material from BHEL/client's stores and storage yard, transportation to site for erection, inspection, preparation of foundation, erection, levelling, centering, alignment, final alignment of Steam turbine, Turbo generator and auxiliaries including associated BOI; Preassembly, erection, alignment, welding, NDT, fixing hangers & supports, oil flushing, water/detergent flushing, hydro testing, & steam blowing of integral piping, oil piping , LP & HP Piping/Power cycle piping; Pre assembly, erection, welding, NDT of water cooled Condenser, feed water storage tank, de-aerator etc., Erection of LP/HP heaters, GSC & other coolers, tanks, flash tanks etc., CPUs and other auxiliaries etc., Cooling Water piping from (Terminal point near A-Row) including RE joints, bellows, BFVs, COLTCS & associated equipment/systems of condenser; Erection and commissioning of Motor Driven & Turbo Driven Boiler feed pumps, Motor driven Condensate Extraction Pumps, ECW pumps, ACW pumps, Misc. Pumps, Hoists etc., supply & application of primer & finish paints / Anti corrosive / steam wash paints including labelling on equipment & piping, Pre-commissioning, commissioning, trial/initial operation & handing over of Steam Turbine, Generator, Auxiliaries, LP and HP piping and insulation works, erection and commission of 3x1500 KVA emergency DG set with its auxiliaries and piping are covered under this contract scope of **Unit No. 2** at **2X660 MW KHURJA TPS, DISTT BULANDSHAHAR, UP.**

2.1 The scope of the work under these contract specifications broadly consists of but not limited to following:

The scope is broadly divided in 02 parts:

a. ETC of STG, rotating and static auxiliaries, integral piping and balance equipment, 3x1500 KVA emergency DG set under Lumpsum scope.
b. ETC of LP, SS, HP/Power cycle piping and insulation as per item Rate on per MT basis.

2.1.1 The ETC works of STG and Its Auxiliaries involved under Lump sum scope are broadly described below:

1. Erection and commissioning of Main Turbine (HP, IP, LP (02 No.'s)) with all auxiliaries and accessories.
2. Erection and Commissioning of Generator, Exciter and Auxiliaries.

3. Erection and Commissioning of all BFPs (Turbine driven + Motor Driven) and auxiliaries.
4. Erection and commissioning of all CEPs along with suction strainers, Motors and other auxiliaries.
5. Erection and commissioning of all MISC pumps including DMCW/ECW, ACW pumps, Drip pumps etc.
6. Erection and commissioning of Gland Steam Condenser, Drain Cooler, LP Heaters, HP Heaters.
7. Erection and Commissioning of Condenser with LP Heater, extraction steam piping and air extraction piping inside condenser steam space up to condenser walls, including Erection, Commissioning & load testing of Condenser water box handling arrangement.
8. Erection, Commissioning of Condenser on load tube cleaning systems and self-cleaning strainers including interconnecting piping, skids and Panels.
9. Generator Stator shifting from Trailer / Outside A-row to the TG deck foundation on TG floor with the help of Portal Gantry Crane. This shall include the shifting and transportation from yard/trailers, erection, commissioning and dismantling of the Portal Gantry crane. BHEL shall arrange OEM personnel, for providing technical support only, for operation of crane during, lifting of stator.
10. Erection (Placement, Shifting, Assembly, Welding, NDT and Hydro testing) and Commissioning of De-aerator and Feed Storage Tank with platform and accessories.
11. Erection and Commissioning of associated integral Piping of STG and all auxiliaries for TD BFP's, MD BFPs, CEPs etc. and other interconnecting piping along with valves, fittings, H&S & insulation etc.
12. Assistance in Grouting of all equipment's as per requirement and in line with instructions of BHEL engineer.
13. Insulation of all equipment's covered under this scope as per Drawing/ design requirement, machineries and other resources as required to carry out the job. The insulation of HWR supplied equipment and piping (details in chapter-X) is not in the scope of this contract. For Haridwar scope of equipment and piping, though the application of insulation is not in the scope of this contract, but the transportation of the HWR scope insulation material from stores to site/TG floor and arrangement of scaffolding for the insulation of equipment and integral piping is in the scope of this contract. Also, Contractor has to make arrangement for provision of sufficient area/local lighting, water supply through hoses of sufficient length for spraying of water for insulation, 3 phase power and compressed air for the insulation vendor, within this lump sum contract scope price.
14. Erection, Alignment, welding and Commissioning of Turbine and Generator Integral piping such as lube oil, governing oil, Generator seal oil system, gas system, Overload pipelines, Jacking oil system, control fluid system, Primary Water system, dirty/ waste

fluid system, Chemical dosing system, Gland steam system - for main turbine (for Hardwar portion of supply) and drive turbines of BFPs (for Hyderabad portion of Supply), Water drainage system, Turbine Governing System with Valves and their Actuators, LP and HP Bypass System with Valves and control system, CRH NRV's with servomotors/actuators and integral piping of other systems, tanks and equipment is also covered under lumpsum scope.

15. Condenser Evacuation system for the 02 condensers of each Unit i.e. Vacuum pumps with connected piping and other integral equipment and piping for each condenser such as Vacuum Breaker line with Valves.
16. Erection and Commissioning of PHE's, Coolers, chemical dosing skids such as NaOH etc., Self-cleaning strainers, Erection, Welding and NDT of Extraction piping such as LP Extraction A1, A2, A3 etc. with sheathing and compensators etc.
17. Erection and commissioning of HT and LT motors of the equipment and auxiliaries, inclusive of CT mounting, testing etc. The greasing of these motors is in the scope of this contract. Complete Field Testing as per requirement of these motors is also in the scope of this contract including supply of the test kits and reqd. equipment and consumables.
18. Arrangement of fixing of steam blowing and hydro-test blanks and restoration in Valves/strainers including removal / restoration in ESV-CV, IV-CV and Over Load lines etc. The assembly and dis-assembly of strainers in valves is also in the scope.
19. Erection of Platforms (with grating, railing, toe-guards and stairs) for safe approach and operation of tanks, auxiliaries and valves etc. which are supplied by Units and also fabricated platforms from free issued material by BHEL, as per BHEL and customer requirement etc.
20. Erection of equipment handling systems, other than that supplied by MU's/Vendors.
21. Flushing, cardboard blasting, steam blowing/washing, acid prickling, purging, hydro-test related testing, pre-commissioning, commissioning activities of lube oil system, governing oil, gas systems, water lines and other systems of Turbine, Generator, Condenser, BFP and other auxiliaries. This includes preparation for flushing, hydro-test, chemical cleaning, steam blowing, other cleaning activities, actual execution of the activities, normalization etc.
22. Setting and commissioning of governing system of Main Turbine and Drive Turbines.
23. Erection and commissioning of drive turbine BFP's with associated auxiliaries such as Gear Box/hydraulic couplings, Lube Oil Consoles, EOP, JOP systems, centrifuge, Oil Accumulators, Governing Consoles ,transition Pieces and enclosure etc. Erection, welding and NDT of ME Joints (Bellows) and BF Valves of exhaust system of drive Turbine.
24. Erection and commissioning of Hoists/HOT Misc cranes, Electric Hoists, Chain pulley blocks.

25. Erection and commissioning of all miscellaneous tanks of water/ oil/ steam /waste systems, PHEs, Self-cleaning strainers, Debris filters etc.
26. Erection and commissioning of 3*1500 KVA Emergency DG set for main plant.
27. **Tentative** material **break up of Systems covered under** Lumpsum scope **is as indicated under Chapter X of TCC.**

2.1.2 The scope of works for **ETC of LP, SS, HP** (**P91, P22, P11, AS, CS,** Power cycle piping etc.) and insulation as per item Rate on per MT basis**, (under the rate schedule item Nos. A.2,A.3,A.4 &A.5) are broadly defined as:**

1. The scope includes erection and commissioning of Piping including pipes, valves, flanges, fittings, fasteners, hangers, supports, insulation and cladding etc. as required for making the system complete.

2. Preassembly, erection, alignment, testing, commissioning, trial operation and reliability operation of equipment and piping systems.

3. Lifting, laying, erection, bolt tensioning, bolt torque tightening, supporting and installation, pre and post weld heat treatment, NDT and inspection, Hydraulic Tests, Acid cleaning, Steam Blowing and other pre-commissioning tests, water / steam flushing, air drying, nitrogen purging of all valves and other miscellaneous in line / on line items is also included. Open ends and other testing of piping installations, above and below ground (if any).

4. Welding, Pre and Post weld Heat Treatment, Non-destructive testing including radiography test, UT and other Non-Destructive Tests, as per approved documents / FQP.

5. Installation of piping valves shall be protected with wooden blanking plates securely fastened with wire of by plastic insert plugs. Any necessary blind or additional valves to isolate lines to facilitate phased commissioning and start-up.

6. Cleaning, pickling, if required, water / steam flushing, air drying disposal of fluids offsite, reinstatement, preservation of piping and miscellaneous items following hydro test, nitrogen purging, cleaning, chemical cleaning, painting, insulation, as per specifications.

7. Fabrication and installation, setting and commissioning of pipe supports, guides, anchors and spring supports as required.

8. Fixing of Insulation, ancillary items and cladding of piping.

9. Execute final painting including supply of paints, painting of all equipment, piping, and structures like platforms, structures etc. Execute Labeling of all equipment, piping (including small bore piping), and structures like platform, pipe rack.

10. Execute all mechanical jobs identified during OWNER / Licensors check list, Technical audits, pre-commissioning and commissioning, including additional supports required to restrain pipe movement avoiding interference with nearby structural / piping.

11. Obtain clearances and approvals from all applicable statutory / Government agencies e.g. IBR, Electrical Inspectorate, Labour Inspectorate etc. Installation of Testing of welds/flanged joints.

12. Preparation of As-Built Drawings.

13. Temporary lines for chemical cleaning shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. After the chemical cleaning has been successfully completed, removing all temporary piping, fittings of tanks etc. checking all the valves for any accumulation of foreign materials, welding the valves, pipes which were cut and cleaning, re-fixing as per BHEL Engineer's instructions is within the scope of work/specification.

14. Temporary lines for Steam blowing of Power Cycle piping shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. All arrangements for erection including welding has to be arranged by the contractor at the within quoted rate. After completion of steam blowing, all the temporary lines to be dismantled and restoration of piping to be carried out, within quoted rate.

15. Other important conditions for piping systems, which the bidder shall consider/take in account:

    I. The welding process, weld joint and material specification may change to suit site requirement.

    II. The list of systems, equipment, PG wise breakup is furnished only for estimation purpose. Vendor will have to erect the final quantities as per drawings/manuals/Shipping list and instructions of BHEL.

    III. Consumables are within the scope of contractor for both temporary and main piping except those which are in BHEL scope. Please refer to SCC (TG PACKAGE) DT. 30.03.22 Clause 4.1.1 for further details.

    IV. The contractor shall weld the joints of site routing piping as per site requirement, no extra payment shall be made for such additional joints.

16. Tentative PG wise break up of System **with weights to be erected for the LP, HP (P91, P22, P11, AS, CS etc.) and SS Piping and all associated piping and insulation works are indicated in chapter-X** of TCC.

Regarding the tonnage indicated, the decision of the BHEL Engineer with respect to scope, and keeping the work suitability, quality and time schedule will be final and binding on the contractor.

The quantities (for lumpsum scope and Piping) indicated in the tender specification are approximate and are liable for variation and alteration at the discretion of BHEL. The work executed shall be measured and priced as per the unit rate arrived at for each work area as mentioned in the relevant clauses.

Piping of **any other material specification not mentioned in the rate schedule/chapter X, but required for completion of the system, shall be carried out as per item rates of respective pressure systems i.e. LP and HP.** The quoted unit rate for lumpsum scope shall be inclusive for any additional product group also, if included at a later date integral to the main scope of work / package envisaged.

Contractor is required to erect actual tonnage (irrespective of any variation plus or minus) which may be necessary to complete their work and commissioning of the above systems and complete the work in all respects as detailed in tender specifications, for which payments shall be released on finally accepted rates as per the rate schedule. Contractor undertakes to erect/ commission actual quantities as per advice of BHEL Engineer and accordingly the final exectued contract price for the item rate portion of the rate schedule shall be worked out on the basis of quantities actually erected at site and payments will also be regulated for the same.

2.1.3 The Common works to be executed under the complete scope of works.

1. Transportation of materials from site store/yard, place of unloading, safe storage with watch & ward of issued material.
2. Checking, Dressing, Chipping, Leveling of foundations.
3. Pre-assembly, Erection, Alignment of various equipment.
4. Welding, Heat Treatment, Radiography, UT and Non-Destructive Tests, as per approved documents / FQP.
5. Assistance during Chemical cleaning of piping, alkali boil out, acid cleaning and passivation etc. as reqd. of the balance system piping and associated testing plus related activities of different system and normalization.
6. Preparation of MIRs, following of safety and quality norms and documentation, preparation of material status and up-gradation of activities, networks at regular intervals.
7. Touch up and finish painting include supply of paints, etc.

8. Necessary Statutory clearances and co-ordination with statutory body such as IBR etc. is within the scope of contractor. BHEL will provide only relevant drawings & documents for the statutory clearances.
9. The contractor shall submit a copy of license to undertake construction / repair of Boilers & Piping issued by Boiler inspectorate before commencement of Pressure Parts / Piping Erection.
10. **Assistance during PG testing of main equipment along with all auxiliaries,** Supply of Manpower during PG Test for installing of Temp and Pressure gauge Sensors, Mounting of thermo-wells etc.
11. Completion of punch points and assistance for handing over of unit (s) to customer. Execution of all Mechanical jobs identified during OWNER Technical audits, check list of pre-commissioning and commissioning. Erection of additional supports required to restrain pipe movement avoiding interference with nearby structural / piping.
12. Unit trial/initial operation of equipment, systems, of 660 MW Unit as a whole, resolving any deficiencies observed in the scope of work and handing over of **Unit No.2** of **2X660MW KHURJA TPS, DISTT BULANDSHAHAR, UP.**
13. Dewatering inside Power house building / CW/CEP pit, TG building, Pump house or any other erection area under scope for equipment erection facilitating is in contractor scope, inclusive of providing de-watering pump.
14. Insulation, touch up and finish painting include supply of paints, etc.
15. Steam Blowing and Safety Valve Floating including Erection and Dismantling of all temporary Piping, Valves, etc. required for above operations and other commissioning activities including post commissioning operations and stabilization of the unit.
16. Supervisors / Engineers, consumables etc., required for the scope of work shall be provided by the contractor. All the expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clause. The contractor's quoted rates should be inclusive of all such contingencies.
17. It shall be specially noted that the contractor's labour and staff may have to work round the clock to meet the completion schedules / plans, which may involve payment of considerable overtime. The contractor's quoted rates should be inclusive of all such contingencies.
18. The terminal points can be inferred from the relevant drawings and any further clarifications can be obtained / decided by BHEL and that is final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals. Carrying out work as per the specification between equipment constituting terminal points, whether the terminal equipment fall within the scope of work/specification, contractor shall carry out the terminal joints at either end. Also where the piping connection to the terminal points involve flanged joints, matching of flanges, fixing gaskets, bolting and tightening as per BHEL Engineers instructions is in the scope of work. In case piping connected to equipment, matching of flanges for achieving the parallelism and

alignment at the equipment end, by suitably resorting to heat correction or other method as instructed by BHEL Engineer, with in the quoted rate.

19. The work shall conform to dimensions and tolerances given in various drawings and quality manuals provided by BHEL. If any portion of work is found to be defective in workmanship not conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be effected from contractor's bill towards expenditure incurred including BHEL's overhead charges.
20. Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less/more at a particular given time. Activities and erection program have to be planned in such a way that the milestone events like boiler light up, steam blowing, SV Floating, synchronisation etc., are achieved as per schedule/ plans.
21. Contractor shall arrange & augment the resources accordingly.
22. No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
23. The storage yard is located within the plant boundary. In principal, majority of the ODC consignments will be unloaded near to erection site as per the space availability. Some other materials may also be unloaded near to erection site as per space availability.
24. All materials have to be transported from storage yard, place of unloading to construction site/foundation by the contractor at its own cost. Arrangement of trailers, for all items except Gen. stator, for shifting from place of unloading /yard to erection site is included in the scope of this contract, for which no extra payment shall be made.
25. Any dragging/shifting for making ODC component in reach of Portal Gantry crane or BHEL crane for erection has to be carried out by Vendor without any extra cost implication.
26. Customer / or their Consultant may depute their representative for checking and supervision of important stages of work. The contractor shall be required to provide all facilities for inspection of works, without any cost implications to the BHEL. Any defect in quality of work or deviations from drawings/ specifications pointed out during such inspection shall be made good by the contractor in the same way as if pointed out by the BHEL Engineer, without any cost implication to BHEL.
27. For further detailed scope of works refer relevant chapters in this book. The bidder shall further understand the scope of erection in line with the list of equipment and piping detailed at chapter X. Any system which may have been left out or added at a later time for completing the system requirement in the lump sum scope of work, will have to be completed by the vendor, with no extra cost to BHEL.

2.2 SITE VISIT

Contractor should visit site and acquire full knowledge & information about site conditions and in & around the plant premises, together with all statutory, obligatory, mandatory requirements of various authorities before submission of bid. Post Award of work NO claim shall be admissible in this regard.

2.3 SITE ORGANISATION

Contractor shall provide adequate staff in the following areas in addition to the staffing requirements of execution as instructed/informed by BHEL:

1. Overall planning, monitoring & control.
2. Quality control and quality assurance.
3. Materials management.
4. Safety, fire & security.
5. Industrial relations and fulfilment of labour laws and other statutory obligations.

i. Contractor shall maintain a site organization of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organization shall be reinforced from time to time, as required to make up for slippage from the schedule without any commercial implication to BHEL. The site organization shall be headed by a competent Project Manager having sufficient authority to take decisions at site.

ii. On award of contract, the contractor shall submit to BHEL its site organization chart indicating the various levels of experts to be deployed on the job. BHEL reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by BHEL, will have to be posted at site and deviations in this regard will not generally be permitted.

iii. Contractor should also submit a list of construction equipment, erection tools, tackle etc., with proper valid test certificates, to BHEL for approval prior to commencement of site activities. These tools & tackles shall not be removed from site without written permission of BHEL.

iv. Organization chart for site should indicate the various levels of experts to be posted for supervision in the various fields in erection, commissioning etc as applicable. For proper supervision of the work, the contractor shall ensure providing one qualified supervisor against deployment of every 15 workmen.

2.4 ERECTION SCHEDULE

Within 15 days of LOI date Contractor shall submit detailed program (L2 schedule) of construction / erection / commissioning, along with matching resources, T&P deployment and manpower deployment schedule for approval to BHEL Site In-Charge/Project manager-Noida. L2 schedule shall be the working level document demonstrating contractor's ability and methods of completing the work within the key milestones identified in the tender specification. This program shall be further detailed showing start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling program with the first month's program being tentative based on the site conditions would be prepared based on these program. The Contractor shall also be involved along with the Customer/BHEL to tie up detailed resource mobilization plan over the period of time of the contract matching with the performance targets. Other requirements are as per Clause No. 2.9 of GCC.

Program shall be jointly finalized by the site in-charge of the contractor with BHEL/Customer's project coordinator as well as the site planning representative. The erection program will also identify the sequential erectable tonnages.

2.5 DEWATERING

I. Contractor shall ensure at all times that his work area & approach/access roads are free from accumulation of water, so that the materials are safe and the erection/progress schedule are not affected. No separate claim in this regard shall be admitted by BHEL. No separate payments for dewatering of subsoil, surface water or catchment water, if required, at any time during execution of the work including monsoon period shall be considered by BHEL.

II. Contractor shall make necessary arrangements to ensure that the atmosphere in working area (under the scope of work in this tender) and on roads is free from particulate matter like dust, sand etc. by keeping the top surface wet for ease in breathing. Provision of required tanker with spraying arrangement has to be ensured by contractor within the quoted rates, at no extra cost to BHEL

2.6 Contractor shall ensure following:

The contractor shall comply with following towards Social Accountability:

a) The contractor shall not employ any employee less than 15 years of age in pursuant to ILO convention. If any child labour were found to have been engaged, the Contractor shall be levied with expenses of bearing his education expenditure which

will include stipend to substantiate appropriate education or employ any other member of family enabling to bear the child education expenditure.

b) The contractor shall not engage Forced/ Bonded Labour and shall abide by abolition of Bonded Labour System (Abolition) Act, 1976.
c) The contractor shall maintain Health & safety requirement as stipulated in the Contract and Contract Labour (Regulation & Abolition) Act, 1970.
d) The Contractor shall abide by UN convention w.r.t. Human Rights and shall be liable for Discrimination/ Corporal Punishment for failure in meeting with relevant requirements.
e) The Contractor shall abide the requirement of Contract Labour (Regulation & Abolition) Act, 1970 for working hours.
f) The Contractor shall abide by the Statutory requirement of Minimum Wages Act 1948, payment of Wages Act 1936.
g) The Contractor shall arrange potable drinking water to its employees & workers.
h) Contractor shall ensure daily housekeeping and keep proper cleanliness of work place and do the disposal of wastes to certified area.
i) Approach and access to erection area is in the scope of contractor.
j) BHEL shall recover the amount of compensation paid to victim(s) towards loss of life/ permanent disability due to an accident which is attributable to the negligence of the contractor, agency or firm or any of its employees as detailed below:

a) Victim: Any person who suffers permanent disablement or dies in accident as defines below:

Accident: Any death or permanent disability resulting solely and directly from any unintended and unforeseen injurious occurrence caused during the manufacturing/ operation and works incidental thereto at BHEL factories/ offices and precincts maintenance, trouble shooting, servicing, overhaul, renovation and retrofitting, trial operation, performance guarantee testing undertaken by the company or during any works/ during working at BHEL Units/ Offices/ townships and premises/ Project sites.

b) Compensation in respect of each of the victims:

I. In the event of death or permanent disability resulting from Loss of both limbs: Rs10,00,000/- (Rs Ten Lakhs)

II. In the event of other permanent disability: Rs 7,00,000/- (Rs Seven Lakhs)

c) Permanent Disablement: A disablement that is classified as a permanent total disablement under the provision to Section 2(l) of the Employee's Compensation Act. 1923.

d) The contractor shall, at all stages of work deploy skilled/semi-skilled tradesman/worker who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesman along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesman are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesman within two days of written notice from Engineer-in-charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesman will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

2.7 Painting (Applicable in entire scope of work): All structures/ equipment/components of piping and lumpsum scope shall be supplied from BHEL units/ workshops with finish coats of paint. Painting (wherever required), incidental to the work, shall be in the scope of the contactor, including supply of the required paints and primers and associated consumables.

Any shop painted structure/component is required to be repainted due to the various reasons such as Mishandling, damage during erection process, other reasons incidental to the work etc, such re-painting/finish painting of the components/structures shall be in the scope of the contractor including the supply of paints and primers along with all required consumables.

2.8 Brief description of major equipment/piping to be Installed, Tested and Commissioned under the lumpsum scope of this contract is given below:

However, changes in design may occur as is usual in any such large scale work for which no compensation will be payable and contractor shall complete the entire work as detailed in tender specifications within finally accepted rates / prices.

Below mentioned details are general and some sub-systems may have been left out. Omission of any system will not absolve contractor from erection and commissioning work of such systems, which are required for the completion and smooth running of the TG and Piping package as per customer contract.

2.8.1) STEAM TURBINE

a) High Pressure(HP), Intermediate pressure(IP) and Low pressure(LP) steam turbine(02 No.s) complete with sole plates, foundation bolts, holding down bolts, casings, bearings, bearing pedestals, rotors, couplings, steam gland seals, electric/hydraulic turning gear etc.

b) Emergency stop(ESV) and control valves(CV), Reheat stop interceptor and control valves, overload valve etc. with their servomotors/HP Governing Actuators, steam strainers & blanking arrangement (strainers may be supplied already erected in the valve) for main and reheat steam lines etc., LP bypass stop and control valves along with their HP Actuators and HP bypass stop and control valves along with their HP Actuators.

c) Cold Re-heat and extraction NRVs along with their servomotors / Actuators, necessary supports, Platforms and secondary structure if required.

d) Complete installation of necessary blanking to protect the valves and turbine internals during hydraulic testing and steam blowing. If required CRH NRV may have to be dismantled and replaced with a spool during steam blowing. It will be re-installed after completion of steam blowing.

e) **Electro –hydraulic governing system** for the turbine including governing control rack, LP bypass Valve & control rack, HP Bypass Valve with control system, Turbine gland sealing system complete with converters, associated piping, valves and fittings, specialties, fire protection valves and devices, hangers and supports to make the system complete in all respects.

f) Erection, welding and NDT of Complete Cross Over piping along with their supports from IP turbine to LP turbines.

g) Extraction piping along with their supports and protective covers from LP turbines to condenser dome walls. The integral and package piping of this contract scope has to be erected, welded, tested along with respective H&S and valves.

h) Complete Overload piping (SA335P91 Material) of overload valve of Hardwar scope. The seal steam and Drain piping is also of the same material.

i) For SA335P91, P92 material piping, the induction heating machine and associated auxiliaries along with DG set shall be supplied by BHEL. All consumables for the process has to be supplied by Contractor/bidder including the welding electrodes and filler wire, ceramic pads, induction coil, insulation for Indn. heating, thermocouple. **BHEL will NOT supply the electrodes/Filler for P-91 welding, as per the clause of Chapter–IV (Clause 4.14) of SCC. The contractor has to procure P91 electrodes/ filler wire for use at site only of BHEL's approved brand.**

j) Turbine Lube Oil System consists of main oil tank, oil coolers, centrifuge, MOP, AOP, AC and DC JOP, DC driven EOP, Leak & Dirty oil tank with pumps, Duplex Filter, vapour fans and auxiliaries, clean oil tank, oil, connected oil piping, valves, H&S etc. The pumps and their motors may be supplied in loose parts, contractor shall have to match / assemble and align at site as per instructions of BHEL Engineer including placement on foundation.

k) Governing system skids: 100% Control oil pumps, control oil tank, filters, control oil purification system, Accumulators etc. HP governing consists of HPSU skids, HP Bypass valve and governing skids along with accessories and piping.

2.8.2) GENERATOR

i.) Hydrogen Cooled Main Generator Consisting of the following:

a) Stator
b) Rotor
c) End Shields & Bearing, Cooler Housing
d) Exciter with Coolers, Enclosures etc.
e) Seal Oil System with Seal Oil Storage Tank
f) Primary Water System including Tanks and Piping
g) H2 Cooling System, CO2 System
h) PW Tank & Alkaliser Unit/Demineraliser Unit (Ion Exchange Unit)
i) Generator package piping along with cooling water and N2 piping.
j) Other Accessories

ii.) ALL WORKS OF SHIFTING THE STATOR TO FOUNDATION, LEVELLING, CENTERING AND ALIGNMENT ETC. WILL BE CARRIED OUT BY CONTRACTOR WITHIN THE SCOPE OF THIS WORK.LIFTING OF GENERATOR STATOR (316 MT): THE STATOR SHALL BE LIFTED WITH THE HELP OF PORTAL GANTRY CRANE (BHEL T&P).

a. **Handling of Stator**- The contractor has to place & install the stator on generator foundation with Portal Gantry crane. Scope under this tender includes shifting of the generator stator from the place of unloading outside A-row or trailer to the Turbo-Generator Deck. For lifting of the stator, Portal gantry crane is to be erected and commissioned. The contractor has to shift the lifting beam, generator lifting slings from storage yard to the bay, and shall assemble and make ready the Portal Gantry Crane, lifting beams and slings to the satisfaction of BHEL engineer. The dismantling of Terminal box or any other fitting of generator may also be required to be carried out before lifting, with no extra cost to BHEL. Matching with base plate/sole plate etc., if required has to be completed before lifting as per BHEL instruction.

b. The Stator weighing about 316 MT (Approx.) will be transported by road and received at site in a special type of low bed high payload hydraulic carrier from

BHEL Hardwar. The Stator will be duly supported and lashed to ensure safe and secured transportation.

c. The unloading of stator from trailer to ground near A-row is in the scope of contractor. For unloading purpose either sleeper jack method or suitable crane can be used by the contractor at no extra cost to BHEL.

d. Transportation of Portal Gantry crane from BHEL Store to site, assembly, erection, dismantling and return to BHEL store, including slings, in good condition is in the scope of contractor.

e. Civil works of Portal Gantry foundations (outside A-row and on TG Deck) including supply of bolts and grouting is not in the scope of this contract.

f. BHEL will provide Stator to nearest location along the side of 'A' row and parallel to the foundation axis across the column of 'A' row of the TG Deck on the trailer for onward handling. The Stator is to be rested on Temporary stools placed over foundation using appropriate means and trailer is to be released. The Stator is to be rested on Temporary stools with adequate ground clearance (approx. 500 MM) so that blue matching of mating surfaces can be carried out before shifting to its foundation on TG Floor at the indicated elevation.

g. Temporary stools – These stools shall be shifted from BHEL stores/ yard to site by the contractor. Any modification in the stools, as required for loading and preparatory works, shall be carried out by the contractor within the lumpsum quoted price. Material shall be issued by BHEL free of cost. The stools shall be returned back to BHEL yard in good condition.

2.8.3) CONDENSER- 02 Nos.

Condenser mainly comprise of the following parts:

i. Bottom Plate , Hot Well, Springs / Bearings
ii. Turbine & generator End side Wall, Dome Walls
iii. LP Heater- To be erected inside condenser
iv. Front & Rear Water Boxes with Tube Plates
v. Tube Support Plates, Stiffening/Support Pipes/Rods, Bars etc.,
vi. Steam Dump devices
vii. Air Extraction Pipe & Baffle Plates
viii. Misc. Fittings & Loose items
ix. Condenser Water Box handling system with crane facilities for maintenance/ withdrawal of tubes and structures, steel columns, beam, bracing, foundation bolts etc.
x. Condenser Tubes- (WELDED AUSTENITIC S.S. TUBES APPROX. 52,960)

2.8.4) AUXILIARIES

a) HP, LP & Unit Flash tanks, DM Water Tanks, Steam Drain tanks, FWSVD tanks, Oil Unloading Vessel and all other misc. tanks with drains & vents, platforms and stairs. The handling system for all auxiliaries as per site requirement will also have to be erected, within this contract.

b) Erection, Preassembly, fit-up, Welding, NDT, Hydro-test and Insulation and Cladding of De-aerator & feed storage tank (in 5 sections), complete with ladders platform and other accessories.

c) GSC, Drain coolers along with fittings, flash boxes, piping, steam traps and gland steam condensers and air exhausters with motor and fittings, associated piping, hangers and supports etc. to make the system complete in all respects.

d) LP and HP heaters, all fittings, group protection device, safety valves, stand pipes along with fittings including gauge glasses for level indication, safety valves etc. to make the equipment complete in all respects. The handling system for all auxiliaries as per site requirement will also have to be erected, within this contract.

e) CW piping (Inlet and Outlet) from terminal point (outside A-Row) including of RE Joints , Butterfly valves with Actuators, Bellows, flanges, Blanks and tie rods and spool pieces, H&S etc. to make system complete in all respect. NDT requirements also to be met as per Drawing.

f) The erection of Self-cleaning strainers (SCS) along with its integral piping, panels, gauges etc. is also in the scope of the contract.

g) Suction strainers for boiler feed and condensate extraction pumps along with supports and other fixtures.

h) Turbine oil coolers, seal oil coolers, along with stand pipes and fittings including gauge glasses for level indication, safety valves etc. to make the equipment complete in all respects.

i) Oil strippers, strainers, oil injectors, Oil centrifuge and duplex oil filters.

j) Main oil, drain oil along with fittings including gauge glasses for level indication, platforms and staircases to make the equipment complete in all respects.

k) Coolers , Tank , Filters, skids, Accumulators etc of Control Fluid System

l) Hydraulic coupling, working oil and lubricating oil coolers of Boiler feed pumps and governing systems and other accessories of TD-BFP.

m) Seal oil storage tank, LLD Racks, CO_2 Vaporisers, Ion Exchange Unit, magnetic Filters, H2 drier, seal oil unit, pre-chambers, gauge glasses along with stand pipes, gauge glasses for level indication etc. etc. to make the system complete in all respects.

n) Hydrogen cooling system, Nitrogen and carbon dioxide systems including H2 dryers, gas control units and gas stands, gas cylinders and racks and distributors to make the system complete in all respects.

o) Exciter air cooler.

p) Turbine Central oil purification system consisting of clean oil storage tank, dirty oil storage tank, central oil purifier, dirty & clean oil transfer pumps, drain oil return pumps, oil unloading vessel & interconnecting piping.

2.8.5) PUMPS AND MOTORS

a) Boiler Feed Pumps (1 Motor Driven & 2 Turbine Driven)

b) 2 Drive Turbine for TD BFP Consists of :
- Turbine Assembly
- Governing Valve Assembly
- Oil Pumps and Lube Oil Console, Oil Coolers etc.
- Gear Box/ Hydraulic coupling
- Connecting Couplings
- The Metallic expansion joints and BF valve of Drive Turbine Exhaust.

c) HT Motor for MD BFP

d) Booster Pumps for BFP's

e) Lube Oil Piping, Working Oil & Cooling Systems & other Accessories for 03 no.'s BFP's –01 No.'s Motor driven and 02 No. Turbine driven

f) Condensate Extraction Pump – 3 no.'s

g) Motors for CEP- 3 no.'s

h) Air evacuation pumps (Vacuum Pumps) for each condenser, including priming pumps for maintaining condenser vacuum, along with motors and its accessories, to make the equipment complete in all respects. 02 Vacuum Pumps for each condenser (Total 04 No. Vacuum pumps / Unit)

i) A.C. and DC motor driven lubricating oil pumps including DC motors starters along with resistance box.

j) Seal oil pumps with drives and fittings to make the system complete in all respects

k) TG-DMCW Pumps

l) ACW Pumps

m) HT Motors for all above pumps & other HT and LT Motors. The greasing, mounting of CT's, testing and commissioning is in the scope of the contractor including of the grease guns, testing kits.

n) The erection and commissioning of the actuators of this contract scope. The commissioning of actuators of valves erected in the TG and auxiliaries is also under this contract scope.

2.8.6) BOUGHT OUT ITEMS

a) Turbine Integral Piping Consists of :

- Lube Oil Piping
- Control Oil Piping
- Seal Oil Piping

- Gland Seal Piping
- Equipment Drains & Vents
- Cross Over Piping
- Air & Gas System Piping
- ACW piping for H2 Coolers including Temp. control Valve
-Overload Piping.
-Other Misc. System/package Piping Etc.

The erection/commissioning of integral piping has to be completed in all respects by the contractor. It may also be required to erect Valves/control valves/Bellows/ steam-traps, fittings, H&S etc. of PEM/ Trichy scope for completion of the system, with no extra cost to BHEL.

b) Air evacuation System (Vacuum Pumps and system)
c) Oil Centrifuge, Portable Lube Oil Purification Unit & Associated System
d) Control Fluid Purification Unit with pumps, Vapour exhauster etc.,
e) 3Way Control Valves, Drain Valves
f) Hangers & Supports, Springs and Dampers
g) Pumps with Accessories (JOP, AOP, EOP, ACW, DMCW, Drip pumps, etc)
h) Vacuum Breaking Device
i) H2 & CO2 Cylinders, N2 Cylinders
j) Fixing of Pick-Ups, Probes & Accessories for Vibration Monitoring System
k) Coupling Covers & Bearing Vapour Exhauster
l) RE Joints & Stretching Bolt Assembly
m) Flash Tanks and Flash Box
n) Butterfly Valves of CW piping

2.8.7) PEM supplied Packages to be erected & commissioned under this scope of work.

a) Plate heat Exchangers (PHEs)
b) Condenser on load tube cleaning system
c) Wet steam washing system.
d) Simplex strainers, Self-cleaning strainers
e) Misc. Pumps such as ACW and ECW/DMCW pumps,Drip pumps with Motor and accessories
f) Miscellaneous electric hoists, Single Girder EOT/Hoist, and Chain Pulley Blocks (Mech. & Electrical). Mono-Rails of the equipment.
g) Lube Oil Pumps.
h) Valves and other fittings of PEM scope which are required to complete integral piping.
i) Chemical dosing system such as NaOH with the integral piping of the skid.
j) Metallic expansion bellows of PEM supply.

k) Erection, welding and NDT of Butterfly valves of Drive Turbine exhaust system with the piping.

l) Insulation for all rotating and static equipment, de-aerator, heaters, strainers, piping and other auxiliaries erected under this scope, except for insulation for equipment supplied by Haridwar for Turbine, ESV & IV Valves and integral piping etc.

2.8.8) Erection and commissioning of 3*1500 KVA EMERGENCY DG SET FOR MAIN PLANT is under this scope of work

I. Unloading, storage and shifting of the following materials from stores to site:

a. 1500 KVA DG Set
b. Acoustic Enclosure
c. 990 Ltrs Fuel Tank and piping
d. Silencers and exhaust pipes and accessories
e. Exhaust support structure
f. Cables and accessories
g. AMF / Control Panels, DBS, Battery charger, Battery
h. Consummables - Lube oil, Coolant and filters
i. Mandatory spares , Tools and tackles

II. Placement of DG SETs (3 nos.) on Foundation
III. Installation/assembly of acoustic enclosure
IV. Erection of silencer, exhaust piping (MS 400 NB pipes, Class-B), silencer support channels , and stack of 30 meters height (MS 400 NB pipes, Class-B)
V. Erection of exhaust stack support structure with platforms (Height- 30 Mtrs) common for two DG SETS
VI. Erection of exhaust stack support structure with platforms (Height- 30 Mtrs) for one DG SET
VII. Insulation and aluminium cladding of silencer, exhaust piping and stack upto 30 Meters height
VIII. Erection of Fuel Tank and Fuel Piping (MS Class 1/1.5 inch Pipes). Flushing of tanks and fuel lines at the time of commissioning. Painting of fuel lines. Filling of 1000 Ltrs of high speed diesel during commissioning
IX. Draining and filling of lube oil and coolant in the engine at the time of commissioning.
X. DG Set Layout drawing and sectional detail is attached. (Annexure-A, after Chapter-XXI)

Miscellaneous equipment drain & vent line according to layout- These are to be completed as per Customer/BHEL's instruction, with no extra cost implication to BHEL.

3.0 FACILITIES IN THE SCOPE OF BHEL/CONTRACTOR

S.No.	Description	Scope		Remarks
		BHEL	Contractor	
3.1.0	**ESTABLISHMENT**			
3.1.1	**FOR CONSTRUCTION PURPOSE**			
A.	Open space for office	**YES**		Free of charge. As and where made available by customer **M/s THDCIL /BHEL**
B.	Open space for storage	**YES**		Free of charge. As and where made available by customer **M/s THDCIL /BHEL**
3.1.2	**FOR LABOUR COLONY**			
A	Open space		**YES**	To be arranged by Contractor **outside plant premises.**
3.2.0	**ELECTRICITY**			
3.2.1.	Electricity for construction purposes (chargeable/free)			**Chargeable** As per **THDCIL** standard rates **Contractor shall install calibrated energy meter for metering electricity consumption.**
3.2.1.1	Single point source	**YES**		As per Construction power provided by customer
3.2.1.2	Further distribution for the work to be done which include supply of materials & execution		**YES**	
3.2.2	**Electricity for the office, weigh bridge, stores, canteen etc of the bidder which include:**			
3.2.2.1	Distribution from single point including supply of materials & service		**YES**	

S.No.	Description	Scope		Remarks
		BHEL	Contractor	
3.2.2.2	Supply, Installation & connection of material of energy meter including operation & maintenance		**YES**	
3.2.2.3	Charges, Duties & deposits including statutory clearances for above		**YES**	
3.2.2.4	Demobilization of the facilities after completion of works		**YES**	
3.2.2.5	Electricity for living accommodation of the bidder's Staff, engineers, supervisors etc. on the above lines	**NA**	**NA**	**No Accommodation inside premises.**
3.3.0	**WATER SUPPLY**			
3.3.1	**FOR CONSTRUCTION**			
3.3.1.1	Making the water available at single point		**YES**	Contractor has to arrange on his own
3.3.1.2	Further distribution as per the requirement of work including supply of materials & execution		**YES**	
	FOR LABOUR COLONY			
	Making the water available at single point		**NA**	**No Accommodation inside premises.**
	Further distribution as per the requirement of work including supply of materials & execution		**NA**	
3.4.0	**LIGHTING**			
3.4.1	For Construction work (supply, erection and arrangement of all materials) 1. At office storage area 2. At preassembly area 3. At construction area b) Providing the necessary consumables like bulbs, tube lights, Switches, etc. for maintaining the lighting system		**YES**	

S.No.	Description	Scope		Remarks
		BHEL	Contractor	
3.5.0	**Commissioning**			
3.5.1	Supply of Power and Water	**Yes**		

3.6 BHEL will not be responsible for any loss or damage to the contractor's equipment as a result of variation in voltage or frequency or interruptions in power supply.

3.7 The Contractor shall be responsible for providing all necessary facilities like residential accommodation, transport, electricity, water, medical facilities etc. at his own cost as required under various labour laws and statutory rules and regulations framed there under to the personnel employed by him.

3.8 Provision of distribution lines of both electrical power and water from the central points to the required place with proper distribution boards observing the safety rules laid down by the electrical authorities of the state shall be done by the contractor, supplying all the materials like cables, distribution board, switch boards, TPN, CBS, ELCBS/ MCCBS/ Copper / Brass clamps, copper conductor, change over switches pipes etc. at his own cost. If any failure is caused in supply of the power and water, it is the responsibility of the contractor to make alternate arrangements at his cost. The contractor shall adjust his working shifts / hours accordingly and deploy additional manpower if necessary so as to achieve the targets. **The energy meter to be installed by the contractor & shall be tested and certified by State Electricity Board or any other agency approved by M/s THDCIL at his cost.**

3.9 The contractor while drawing construction power supply from Distribution Board should strictly adhere to following points.

a) All electrical installations should be as per Indian Electricity rules.

b) All distribution Boards installed by the contractor should be constructed with fireproof materials viz. Steel frames, Bakelite sheets etc.

c) Connection for single phase should be taken from phase and neutral. Nowhere the connection should be taken with earth as neutral.

d) All electrical connections should be made through connectors, nuts and bolts, switches, plug and sockets. Loose connections or hooking up of wires shall not be permitted.

e) Contractor have to make their own earthing arrangement for their equipment / DB earthing.

f) All electrical equipment / tools and plants should be properly earthed. DBs to be earthed diagonally opposite at two points.

g) Contractor should use "MCCB" and "ELCB" either on incoming or outgoing connections to the DBs.

h) Contractor should ensure that all the CBs / TPNs/ Fuses/ MCCB / ELCB cables etc. should be of adequate rating/ capacity.

i) For permission of supply connections contractor has to submit a test report of their installations with a single line diagram of connected/ proposed loads.

3.10 ELCB will be tested once in a week or as directed by BHEL by actually simulating the earth leakage for all installations and the same shall be recorded in the logbook to be maintained by the contractor.

3.11 In case of power cuts / load shedding no compensation for idle labour or extension of time for completion of work will be given to contractor.

3.12 On completion of work or as and when required by BHEL, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and levelled and debris shall be removed, as per instructions of BHEL, by the contractor at his cost. In the event of his failure to do so, BHEL will get it done and expenses incurred shall be recovered from the contractor along with prevailing overheads. The decision of BHEL Engineer in this regard shall be final.

3.13 **NIL**

3.14 **DRINKING WATER -** Bidder shall provide drinking water at the work spot at their own cost.

3.15 Compressor of required capacity for construction purposes shall be arranged by Contractor.

3.16 **OTHER FACILITIES:** Adequate water less urinals, at least 2 nos, and toilets, at least 2 Nos., shall be arranged by the contractor within quoted rates, at site of construction with proper disposal arrangement.

3.17 **CONSUMABLES:**

a) Such of those consumables as indicated as consumables provided by BHEL alone will be provided to the contractor by BHEL free of charge for erection activities. Other required consumables like electrodes, all gases, and other materials for this scope of work are to be arranged by the contractor at their cost.

b) The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including P91,P92, alloy steel, CS,MS and stainless steel etc.), all gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding and pre-assembly materials, hardware items etc required for temporary works such as supports, scaffoldings, bed are to be arranged by him. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by him.

c) Also, the special sealing compounds, high temp. lubricants, specialty cement Nitomortar, for final assembly of STG which also go finally as part of equipment, also shall be supplied by contractor within this contract scope. Such compounds/material has to be procured by the vendor, as per the drawing specifications/Brand-Make, after consent and approval of BHEL Engineer. BHEL engineer's decision in this case shall be final and binding on the vendor. In case of delay in procurement or deviation in specification of the material, BHEL shall procure the same on risk and cost of the vendor.

d.) The following materials that will go as a part of the permanent system of the plant will be supplied by BHEL at free of any charges: Shims, Packers, Pipes, valves, flanges, fittings, Gaskets, fasteners, GP2 for grouting etc. All other consumables (whether for permanent or temporary work) for carrying out the erection work shall be supplied by the vendor, except, for any consumables supplied by the MUs.

3.18 GASES

3.18.1 All the required gases like Oxygen / Acetylene / Argon /Nitrogen etc. required for execution of work shall be supplied by the Contractor at his cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non availability of gases cannot be considered as reason for not attaining the required progress.

3.18.2 BHEL reserves the right to reject the use of any gas in case required purity is not maintained.

3.18.3 However all gases required for commissioning/ equipment filling/operation of plant shall be provided by BHEL free of cost. Handling of filled/empty gas cylinders, transportation to yard, filling station inside/ outside power plant is in the scope of vendor.

3.18.4 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

3.18.5 The contractor shall ensure safe keeping of the inflammable cylinder at a separate place away from normal habit with proper security etc.

4.0 T&Ps AND MMEs DEPLOYED BY CONTRACTOR

S.NO.	EQUIPMENT	CAPACITY	QTY. IN NOs
1.	Crawler/Tyre Mounted Crane	40 MT	1
2.	Tyre Mounted mobile Crane/ Hydra	14 MT/15MT	2
3.	Trailer with Pulling Unit	40 MT	1
4.	Low Bed Trailer	APR*	1
	*The scope of shifting of material from yard/place of unloading to erection site is in the scope of Contractor. Contractor has to arrange appropriate capacity trailer (as per requirement) for shifting of the material from stores/Yard/ place of unloading to site and vice versa (in case of material reconciliation and return to stores). The trailers are to be arranged as per handling requirement for the equipment detailed in **Chapter X** (of TCC). Cranes shall be provided for loading on trailers, only for material beyond handling capacity of 40 MT crane of the contractor.		
5.	Electric Winch	3/5/10 MT	APR
6.	Drilling Machines		APR
7.	Surface Grinder and other Workshop Equipment		1 set each
8.	Welding Sets, TIG welding machine with accessories and ovens for welding electrodes baking and holding.		APR
9.	Oxy- acetylene Gas Cutting Set		APR
10.	Hoisting & Pulling Devices/ Chain Pulley blocks of various & suitable capacities etc		APR
11.	Hydraulic Jacks	25/50/100 MT	APR
12.	Screw jacks	5/10/25/50T	APR

S.NO.	EQUIPMENT	CAPACITY	QTY. IN NOs
13.	Welding sets with accessories and ovens for welding electrodes backing and holding		APR
14.	Heat Treatment and Stress Relieving sets including heating coils, panels, Recorders Etc		APR
15.	Industrial Vacuum Cleaner		02 no./APR
16.	Hydraulic Pipe Bending machine (Manual and Motorised) of various sizes		1 No each/ APR
17.	Torque Wrench Up to 4000 NM Range (Hydraulic)		APR
18.	Electronic / Electrical Tube Expander (With Tools)		6 no.
19.	Air Compressor	140 / 210 CFM	1 no.
20.	Profile making M/C		APR
21.	Nibbling M/C		APR
22.	Shearing M/C		APR
23.	Portable grinding M/C		APR
24.	Portable drilling M/C		APR
25.	Chain Pulley blocks	02 MT- 20 MT	APR
26.	Fire retardant Tarpaulins		APR
27.	Fire Extinguisher		APR
28.	**Radiography arrangement including source**		2 source/ APR

S.NO.	EQUIPMENT	CAPACITY	QTY. IN NOs
29.	Pipe Chamfering Machine/ Tube Cutting		APR
30.	Three phase DB with complete set up for drawl and distribution of construction power		APR
31.	Electrical cables for drawl and distribution of construction power, heating machines		APR
32.	Sleepers of suitable sizes		APR
33.	Concrete block for pre-assembly bed		APR
34.	Various sizes of clamps/ fixtures for assembling		APR
35.	Dewatering pumps		APR
36.	Recordable UT test Equipment suitable to meet the requirements (KRAUTKRAMMER MODEL USN 50 or EQUIVALENT)		APR
37.	Ultrasonic Hardness Testing Machine [Ultrasonic contact impedance (UCI)]		APR
38.	Annealing cables have to be arranged by the contractor within the quoted rates.		APR
39.	Long feeler Gauge set		APR
40.	Inside and Outside Micrometers, (With Calibration certificates and LC-0.01mm), Three Pin Micrometers	From 50 mm - APR	2 Nos.
41.	Inside - Outside Calipers, Precision Depth Gauges		APR

S.NO.	EQUIPMENT	CAPACITY	QTY. IN NOs
42.	Allen Key sets, Tape and die sets		APR
43.	Gas Cutting Sets		APR
44.	Pull Lifts - 3.6 / 6 / 10 T		APR
45.	Tools for Reaming and Honing		APR
46.	Hand Tool Sets		APR
47.	Taper Pin and straight Pin Reamers		APR
48.	Torque wrenches, Impact Drive Sockets.		APR
49.	Ratchet Square insert (MM size and Inch size)		APR
50.	Dry Paint thickness gauge ,Ultra sonic testing set		APR
51.	Double End,Single End,Ring, Box, Hammering spanners		APR
52.	Electrode drying cabinet (Master baking Oven)		APR
53.	Wire Rope Slings, D-Shackles, Belt Slings, Hook Chooks, Chain Pulley Blocks		APR
54.	Magnetic Base Drilling Machines, Grinding Machines, Cutting Machines, Argon Sets, Gas Cutting Machines		APR
55.	Dial Gauges of different ranges and types including lever dial gauges(with LC 0.01mm)		APR

S.NO.	EQUIPMENT	CAPACITY	QTY. IN NOs
56.	Micro- ohmmeter for winding resistance of Rotor and other electric machines (HT/LT) of the contract scope- contractor has to arrange digital micro-ohmmeter.		APR
57.	Digital Megger	5KV	1 No.
58.	NDT test kits		APR
59.	DFT measurement (Alcometer)		APR
60.	Dumpy level	0 to 350 mm, LC-0.01	01 No.
61.	Surface plate	Up to 1.0 Sq. Mtr, Grade 1,2,3	APR
62.	Straight Edge	Up to 2 Mtr. Long, Grade 1,2,3	02 No.
63.	Hardness testing equipment (Equotip or Microdur make)		APR
64.	Digital Temperature Indicator.		APR
65.	Magnetic particle testing equipment DRY & WET Type		APR
66.	DPT Kit		APR
67.	Elcometer for paint thickness checking		APR
68.	Hand Operated Megger 500/1000V		APR
69.	Tong Tester 10,20 or 50 Amp +/-3% accuracy		APR
70.	Digital Multi meter 4½ digit		02 nos./APR
71.	Scaffolding Pipes		Min. 1000 Nos/ APR

S.NO.	EQUIPMENT	CAPACITY	QTY. IN NOs
72.	Master Level		APR
73.	Pressure Gauges of multiple ranges	0-800 Kg/cm2	APR
74.	Hydro test Pump	250 Kg/cm2	APR
75.	Auto Continuous variable Transformer - VARIAC (measuring impedance of generator rotor)	minimum 310 V and 100 Amp rating	APR
76.	Formaldehyde Gas Analyser		APR
77.	Portable Gas Detector (Oxygen Analyser)		APR
78.	Temperature Gun		APR

Note: "APR" is defined as: - Contractor has to deploy T&P AS PER REQUIREMENT of BHEL site as decided by BHEL Engineer In-charge. The capacity, quantity, duration of deployment shall be decided by Engineer In-charge as per site requirement in view of the front availability and erection program. The requirement of the T&P/Crane etc. shall be recorded in the respective month Form-14 and accordingly deployment/non-deployment shall be recorded in next month's Form-14 of the contractor. Decision of BHEL Engineer In-charge with respect to requirement of particular T&P shall be final and binding on the contractor.

4.1 The above list specifies only major T&Ps (tentative, may not be complete) to be deployed by the contractor and is based on minimum requirement. All additional / other tools and plants including suitable capacity D shackles, slings, rails, sleepers, hydraulic / mechanical jacks etc which are required for satisfactory & timely completion of work shall also be deployed by the contractor within finally accepted rate / price. Any special testing kit/ MME/ T&P/ precision equipment, other than supplied by the MU/manufacturer (in case of BOI's) as special equipment for erection/testing or provided by BHEL, has to be arranged by the contractor within final accepted rates.

4.2 **The above list is only indicative and these T&Ps may not be required for entire contract period but contractor shall ensure the availability of the T&Ps as per work requirement and T&P Deployment schedule.**

T&P Deployment schedule shall be finalized at site in consultation with BHEL Engineer, prior to commencement of work, based on the work fronts/work requirement. BHEL decision shall be final and binding regarding the T&P deployment schedule. Contractor shall mobilize / maintain the T&P's as per the deployment schedule notified time to time by BHEL Engineer.

4.3 If any one of T&P mentioned above is not needed for proper execution of scope of work, provided contractor has not utilized BHEL free issued T&P for completing such work, no recovery from contractor shall be applicable.

4.4 Any additional item required in addition to above mentioned T&P except crane ≥100 T for proper execution of scope of work, contractor has to arrange such T&P within quoted rate on the instruction of BHEL within two weeks.

4.5 Gas Burners arrangement with required gas for maintaining temperature in the event of power failure.

4.6 **CONSUMABLES FOR P91 WELDING – CONTRACTOR SCOPE:**

I. Glass Fibre Cloth -1mmx1000mm–Temp Rating 1260ºC.
II. Glass fibre cord Dia 3mm (twisted)- Temp Rating 1260ºC.
III. Ceramic Fibre Blanket -RT Grade, density 96 kg/m3 –Temperature rating 1260ºC.
IV. Ceramic fibre rope- Fibre Glass Braided, Dia 12 mm –Temperature rating 1260ºC
V. K Type Thermocouple- 0.5 mm Dia Single Strand individual fibre glass insulated.
VI. Heavy Duty TC connectors for K Type Thermocouple.
VII. All other consumables / equipment to carry out the work.
VIII. Compensating cable & Heating Elements (Annealing cables)
IX. Fillers and Electrodes for P91 welding. The approx. tentative quantities of filler wire and electrodes for P91 and P92 as per Table-1.

Table-1

Welding Consumables (Special Catgory) for P92 and P91 material in Turbine Integral Piping					
SL. No.	**Description**	**Run**	**Unit**	**Qty reqd. for P91 material**	**Qty reqd. for P92 material**
1	Weight of Wire	Root Run	kg	35	35
2	Weight of electrode of **3.15mm** size	Main Run	kg	75	95
3	Weight of electrode of **4mm** size	Main Run	kg	200	230
4	Weight of electrode of **5mm** size	Main Run	kg	120	150

5	Number of electrode of **3.15mm** size (Considering 22 nos of electrodes per kg)	Main Run	No.	1700	2200
6	Number of electrode of **4mm** size (Considering 16 nos of electrodes per kg)	Main Run	No.	3000	4000
7	Number of electrode of **5mm** size (Considering 10 nos of electrodes per kg)	Main Run	No.	1200	1600
Note: The above quantities are tentative and it may be vary as per actual site requirement.					

4.7 Special T&P or IMTE's requirement for tests like Helium leak detector test, Holiday testing, UV lamps for fluorescent dye Test of condenser shall be arranged by contractor as per site requirement.

4.8 Any T&P's, Cranes, Slings, D-shackles and other lifting tackles, Trailers required for shifting of material from store to site shall be arranged by contractor over and above T&P's/ crane provided by BHEL. The contractor has to arrange for trailers (Low Bed and normal) of required capacity for shifting of the material from stores, yard and any other place of unloading of material/equipment.

4.9 **In case the contractor does not deploy or delays deployment or deploys for a shorter period of major T&P with reference to schedule specified or T&P deployed is out of service/non-available for continuous more than 5 days or cumulative downtime/ non-availability of 10 days in a month, BHEL will recover non-refundable penalty per day in the following manner:**

a) 40 MT crane- @ Rs 5000/- per day
b) 14/15 MT hydra crane - @ Rs 3000/- per day
c) 40 MT Trailer - @ Rs 4000/- per day
For the daily recovery rate for other T&P/IMTEs BHEL Engineer decision shall be final and binding on the contractor.

4.10 In case BHEL had to deploy its own T&P, hire charges of T&P applicable for outside agencies as per extant guidelines for "Hire Charges on issue of Capital Tools & Plants" shall be recovered.

In case BHEL had to deploy the T&P from outside agency, actual hiring cost plus applicable overheads shall be recovered.

4.11 In addition to the deduction mentioned in clause 4.9 above, if work gets delayed due to non-availability of any T & P, BHEL reserves the right to get the work done at the risk and cost of contractor.

4.12 In case BHEL had to deploy its own T&P, hire charges of T&P applicable for outside agencies as per extant guidelines for "Hire Charges on issue of Capital Tools & Plants" shall be recovered.

In case BHEL had to deploy the T&P from outside agency, actual hiring cost plus applicable overheads shall be recovered.

4.13 All the tools and tackles/measuring instruments shall be duly tested/calibrated and valid certificate to that effect should be submitted to BHEL site in-charge before the start of work.

4.14 If the work related to T & Ps mentioned above is completed then, BHEL can release that T & P during contract period / extended period, if any. However, written permission shall be taken by contractor from BHEL Site Construction Manager for releasing the T&P.

5.0 T&Ps AND IMTEs DEPLOYED BY BHEL ON SHARING BASIS

LIST OF T&P BEING PROVIDED BY BHEL ON FREE OF HIRE CHARGES AND ON SHARING BASIS				
Sl. No.	**Equipment**	**Capacity**	**Qty.**	**Remark**
1	**PORTAL GANTRY CRANE**		1 No.	Free issue for Stator Lifting
2	**CRAWLER CRANE**	250/ 270 MT	1 No.	On sharing basis as per requirement
3	**CRAWLER CRANE**	135 MT	1 No.	On sharing basis as per requirement
4	**CRAWLER CRANE**	100 MT	1 No.	For material loading at BHEL store (For material beyond scope of 40 MT crane)
5	**EOT Cranes at TG Hall without operator**	140 / 25 MT	1 No.	On sharing basis (Power is chargeable)
6	**EOT Cranes at BC bay for TDBFPs without operator**	35 MT	2 No.	
7	**Slings for lifting turbine rotors with lifting beam**		One Set	
8	**Slings for lifting generator stator with lifting beam**		One Set	
9	**Temporary stool for Stator Placement**		One Set	Modification/Fabrication APR in vendor scope.
10	**Digital Micro-ohmmeter for checking/measuring winding resistance of the Generator stator and HT Motors.**		APR	On sharing basis
11	**HT PUMP**	(0-20 Kg/cm^2)	1 No.	On sharing basis
12	**CHEMICAL CLEANING ARRANGEMENT**			By BHEL agency (Assistance by Bidder)

NOTES:

1. **a) <u>For BHEL's cranes 75 MT & above:-</u>** Day-to-day upkeep and running maintenance like filling topping up of lubricants, changing filters, etc. including repair of self-starter, batteries and dynamo of these cranes shall be excluded from the scope of the contractor.

   b) <u>For BHEL's cranes below 75 MT capacity:-</u> Day-to-day upkeep and running maintenance like filling topping up of lubricants, changing filters, etc. including repair of self-starter, batteries and dynamo of these cranes shall be responsibility of the contractor. If on checking it is found that the same is not followed, BHEL shall exercise its right to get the job/works done at the risk and cost of the contractor.

   c) Common for above Sl. No. (a) & (b):- In case of breakdown of crane, contractor shall provide the necessary manpower for maintenance of the BHEL owned crane to maintenance agency (deployed by BHEL), failing to do so BHEL will get the job done at the risk and cost of contractor. BHEL may also provide cranes through crane hiring agencies in which case the day-to-day upkeep and running maintenance shall also be excluded from scope of contractor. The contractor shall arrange fuel for the operation of hired & BHEL owned cranes also.

2. The Cranes at Sl. No. 1 will be provided as per requirement and availability at the sole discretion of the BHEL Engineer.

3. **a) <u>For BHEL's cranes 75 MT & above</u>: -** The operator, helper & maintenance personal (Engineer/Technician/OEM) for BHEL's cranes 75 MT & above capacity being provided by BHEL free of cost. The contractor shall provide fuel for the operation of hired & BHEL owned cranes for its scope of work, without any extra cost.

   b) <u>BHEL's cranes below 75 MT capacity: -</u> The operators for BHEL's cranes 75 MT below capacity shall be provided by the contractor free of cost. These operators should possess valid license for heavy vehicle. The contractor shall provide fuel for the operation of hired & BHEL owned cranes for its scope of work, without any extra cost.

4. The contractor shall make necessary arrangement like laying of special sleeper beds, assembly & dismantling of heavy lift attachment, boom, jib etc. for movement and operation of crane.

5. **EOT Crane –**Trained operators are to be arranged by the contractor within the quoted rates. Contractor has to plan the activities on item wise where the EOT crane is required to be used and submit to BHEL site for approval. In case the erection can be carried out by using other T&Ps, contractor shall make his own arrangement. The decision of BHEL engineer on this will be final and binding to contractor. In some cases EOT crane may have to be shared with other contractors of BHEL working in the Powerhouse for that Contractor has to manage and coordinate with them itself. Electricity for EOT crane usage shall be chargeable.

Providing manpower assistance required for free movement of trailing cable (BHEL provided) of EOT Crane is **included in the scope of contractor**. Contractor has to take due care of Trailing cable issued for EOT crane and is to be returned to BHEL in Good working condition after commissioning of EOT DSL.

BHEL will not provide crane operators for EOT cranes. Trained operators for EOT crane **to be arranged by the contractor** at his cost.

6. Cranes are only for erection/lifting purpose and shall not be available for material transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.

7. Other T&P mentioned above, contractor shall transport from BHEL stores, install, operate, carry out maintenance, dismantle after use and return to BHEL stores or as specified by BHEL.

8. In case of non-availability of these equipment's, due to any reason i.e., unavoidable breakdown, major overhaul or any other reason etc., the contractor should make arrangement at his own cost to meet the erection targets. No extra claim will be admitted due to non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.

9. The Contractor shall be responsible for the safe and proper use of the above equipment issued to his. Day-to-day maintenance and operation of equipment's shall be the contractor's responsibility and shall be as per instructions / standard practice of BHEL Engineer.

10. The contractor shall return the T & P issued to him by BHEL in good working condition as and when so desired by BHEL. (Completion or reduction in work load) for diversion for other work. If such return is delayed by contractor due to his fault without written consent of BHEL, hire charges as applicable according to BHEL policy will be levied from such time it was requisitioned by BHEL to the time of actual return and the amount so decided and arrived at, will be recovered from the contractor's bill.

11. Contractor shall have at all times experienced operators and technicians for routine and breakdown maintenance of the equipment. Any delay in rectification of defects will warrant BHEL rectifying the defect and charging the cost to the contractor.

12. If at any time it is noticed that contractor is not using any of the T & P or equipment properly according to the instructions of BHEL, BHEL will have the right to withdraw any and all such equipment and any cost due to this shall be contractor's account.

13. All the T & P would be issued only at BHEL stores and it shall be the responsibility of the contractor to take delivery from BHEL stores, transport the same to site and return the same to BHEL stores in good condition after use.

14. Contractor shall make good any loss or damage to the equipment/EOT supplied to him and day to day maintenance and operations of equipment shall be borne by the contractor including all consumables like petrol, oil, air filters, contactors, bush, etc.

15. Any Loss / Damage of tools by the contractor, the same shall have to be replaced by the contractor or otherwise cost thereof shall be recovered from the contractor.

16. Any loss / damage to any or part of the above equipment shall be to contractor's account and the expenditures on these account will be recovered from contractor's bills in case contractor fails to make good the loss.

17. Any other special T&P if supplied by the manufacturer and available with the customer may also be provided to the contractor free of hire charges as and when made available. Special tools and tackles are to be used only for the purpose for which these are meant and to be returned in good condition. However low height jack may not be made available and will have to be arranged for by the contractor.

18. Other terms and conditions regarding above items shall be as per T&P clause in SCC.

Cranes provided by BHEL will be on sharing basis with other agencies / contractors of BHEL. The allocation of cranes shall be at the discretion of BHEL engineer, which shall be binding on the contractor. Cranes will be deployed at appropriate time as decided by BHEL for suitable duration and intended purpose. Augmentation of BHEL T & P under special circumstances shall be discretion of BHEL .

6.0 TIME SCHEDULE

6.1 INITIAL MOBILIZATION

After receipt of LOI, contractor shall discuss with Project Manager / Construction manager regarding initial mobilization. Contractor shall mobilize necessary resources within **15 days of issue of Letter of Award** or as per the directive of BHEL. Such resources shall be progressively augmented to match the schedule of milestones and commissioning. However, BHEL Engineer will certify the actual date of start of work (**Zero Date**) after adequate mobilization of manpower, major equipment and other T&P by the contractor.

6.2 PROGRESS PLANNING AND MONITORING

Contractor along with BHEL have to prepare erection plan on monthly basis for activities to be carried out, manpower requirement and mobilization plan, T&P required and mobilization plan, based on the available fronts and in broader view of the contractual completion schedule or any compressed schedule agreed upon with customer. Such progress plan and monitoring has to be diligently recorded in the monthly Form14s, which shall subsequently form the base of delay analysis for time extensions, if any.

Contractor shall augment his resources in such a manner that daily erection activities shall be completed on daily basis, SUCH AS TO MEET THE MONTHLY PLANS and the entire work is completed within the time schedule/contract period. Augmentation of resources
(Manpower and T&P) shall be mutually discussed and agreed upon for the purpose of uninterrupted work. In case of any dispute, BHEL's decision shall be final and binding.

6.3 CONTRACT PERIOD

Entire work as detailed in the tender specifications shall be completed within **20 (Twenty) months** from the Zero date as per program / milestones indicated by BHEL Engineer. Contractor has to mobilize adequate resources to meet BHEL's commitments to their customer as indicated from time to time.

Entire work under this specifications shall be carried out in accordance with the broad schedule as furnished below, within the stipulated completion period. This schedule will undergo review and based on progress vis-à-vis project requirement, contractor shall submit revised schedule for approval of BHEL/Customer

Project Schedule	MONTH	Milestones
Start of Erection	Zero Date	(1st Month)
Commencement of Condenser Erection	1st month	
Commencement of Turbine Erection	2rd month	
Commencement of Piping works	4th Month	
TG Box-Up (LPT)	9th month	M1
Readiness of Piping for Alkali/detergent flushing	11th Month	
Completion of Oil Flushing	12th month	
Barring Gear	13th month	M2
Readiness of Piping systems (with insulation ,cladding) for synchronization and Full loading	14th month	
Rolling & Synchronization	15th month	
Trial/Initial Operation	17th month	
Completion of facilities	20st month	

Provision of Penalty in case of slippage of Intermediate Milestones:

M1 & M2 are the intermediate LD milestone. Milestones LD shall be applicable if the delay in achieving the milestone is solely attributable to the contractor.

1. In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones
2. In case delay in achieving M1 Milestone is solely attributable to the contractor, 0.5% per week of executable contract value*, limited to maximum 2% of executable contract value, will be withheld.
3. In case delay in achieving M2 Milestone is solely attributable to the contractor, 0.5% per week of executable contract value*, limited to maximum 3% of executable contract value , will be withheld.
4. Amount already withheld, if any against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 Milestone.
5. Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment

(corresponding RA Bill) and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.

6. Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion/ closure of contract. Withheld amount, if any due to slippage of identified intermediate milestone(s) shall be adjusted against LD or released as the case may be.
7. In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted into recovery

**** Executable Contract Value - Value of work for which inputs/ fronts were* made *available to contractor and were scheduled for execution till the date of achievement of that milestone.***

6.4 Contractor shall plan their work in such a manner so as to meet the above project schedule, in consultation with BHEL. To achieve the above schedule contractor shall work in all the available fronts concurrently and be prepared for working in the shift operation as per the instruction of BHEL Engineer.

6.5 Completion of facilities shall be considered completed in all respects only when on successful erection, trial run of individual equipment's and successful commissioning, trial/initial operation, attending punch points and entire scope of work as per contract.

6.6 Work under the scope of this contract shall be deemed to have been completed in all respects only when so certified by BHEL. The decision of BHEL Construction Manager shall be final and binding on the contractor.

6.7 If the completion of work as detailed in the scope of work gets delayed beyond the contract/ completion period, the contractor shall request for an extension of the contract and BHEL at its discretion may extend the contract as per the GCC clause 2.11.

6.8 Commencement of performance guarantee shall be as per clause no. 2.24 (Performance Guarantee for Workmanship) of General Conditions of Contract. **The commencement of guarantee period for the quality of the workmanship shall start from the date of trial/initial operational acceptance of facilities OR handing over to the customer, whichever is earlier**.

7.0 TERMS OF PAYMENT

7.1 BHEL Engineer will certify regarding the actual work executed in the measurement books and bills, which shall be accepted by the contractor in measurement book.

7.2 Contractor shall submit bills for the work completed under the specification, once in a month detailing work done during the month. The format for billing shall be approved by BHEL before raising invoices.

7.3 Subject to any deduction, which BHEL may be authorized to make under the contract, the contractor on the certificate of the Engineer at site be entitled for payment as explained hereunder.

7.4 These are divided into 02 parts i.e.

(I) Pro-rata payment (85% of the CV)

(a) lump sum scope and

(b) Items executed under Item rate on per MT basis.

(II) Milestone payments (15%) for Sl. No. I(a)& Sl. No. I(b).

I(a) 85% of Lump sum scope(Item No.A.1 of rate schedule) is subdivided as:

A	CONDENSER* (Weightage 20% = 2x10%, 10 % for each condenser)	%
1	Preparation of Foundation ,Erection and Alignment of condenser supports	2%
2	Placement, Alignment, Pre-Assembly and welding of Bottom Plate segments, Hotwell and NDT	8%
3	Assembly and positioning of water chamber, side walls, Welding and NDT	12%
4	Assembly, Erection, alignment and welding & NDT of Tube support plates and condenser internals like Baffle Plates, Air Evacuation pipes etc.	15%
5	Transportation, Hole cleaning, Insertion, Expansion, Cutting etc. of Condenser Tubes	13%
6	Assembly, Welding & NDT of Lower and Upper Dome Walls and Dome Stiffeners, Extraction Piping and Steam Dump Device, LPH with Supports etc.	12%
7	Hydro Test of Water Side, Water fill Test	10%
8	Condenser Floating, Welding of Condenser Neck Joint and NDT & Completion of Balance works as erection of stand pipes and vacuum breaker valves etc.	10%
9	Erection, Commissioning, Load Testing of Condenser Water Box Handling System.	3%
	Sub- Total for Condenser	**85%**

B	**TURBINE (1HP+ 1IP+ 02 LPs* = 24%)**	
1	Preparation of Foundation, Placement and Alignment of Turbine Bearing Pedestals and Base Plates of LPC.	5%
2	**LP Turbines- 02 Nos.**	
2a	Placement, Alignment ,welding of Centre Guide Pins, LPT Front and side walls to form Outer Casing Bottom Portion	7%
2b	Assembly, welding of Casing Frame Section and bracing pipes in LPT outer casing bottom half and complete NDT.	9%
2c	Erection, Alignment of Inner Casing, Placement of LP Rotor and checking of Blade Clearance, axial and radial flow paths.	7%
2d	Fitment, Assembly and Welding of LPT Outer Casing Upper Part	2%
2e	Erection of shaft seal assembly and expansion joints	1%
2f	Boxing up of LP Inner casing and all associated checks.	2%
2g	Final Box up of LP Turbine No.1 and No.2	5%
3	**IP Turbine**	
3a	Placement And Alignment of LP Turbine Outer Casing And Inner Casing (Lower Halves)	2%
3b	Placement And Alignment Of LP Rotor With Lower Casing And Fixing Of Seals Etc.	5%
3c	Boxing Up Of Inner & Outer Casing (Upper Halves) And Associated Checks Roll Check, Centering, Horn Drops Etc.	3%
4	Placement of HP Turbine, Lowering of HP Rotor on Bearings and Checking of Clearances , Roll check, centering, Erection of Turning Gear assembly.	7%
5	Alignment of All Rotors including Reaming, Honing and Fixing of permanent Coupling Bolts, CRO and swing check	9%
6	Erection and commissioning of HPSU for ESVs and IVCV valves ,LPBP control Unit System/Equipment, skids with all accessories	5%
7	Installation and alignment of ESVS, IV&CV, LPBP Valves, Overload valve along with supports and Actuators	9%
8	Erection, Alignment and Welding, NDT of Cross Over Piping and Over Load piping.	5%
9	Assembly of Hydro Test and Steam Blowing Devices in ESV,IV and LPBP valves, and Normalization etc.	0.50%
10	Final Boxing Up of Pedestals after Oil Flushing Completion	1.50%
	Sub- Total for Steam Turbine	**85%**
C	**TURBO GENERATOR (12%)**	
1	Preparation of Foundation, Levelling and Matching of Foundation Plates.	4%
2	Lifting & Placement on Foundation (by Portal Gantry Crane), Levelling, centering and Alignment of STATOR(including erection and dismantling of portal crane, used for stator lifting)	16%

3	Fixing of End Shields of upper and lower half	4%
4	Rotor Threading and Air gap Checking	8%
5	Final Boxing Up of Generator ,completion of all works as erection of seal ring holder and seal ring on both sides, Generator coolers	12%
6	Alignment of Generator Rotor with LP Turbine Rotor, Run-out checks and Reaming, Honing of Coupling holes and Fixing of Coupling Bolts	9%
7	Erection of Exciter & Alignment of Gen-Exciter Rotors including swing check and completion of Balance Works	10%
8	Completion of Generator and exciter integral piping in all respect including of PW system including Stator Primary Water Piping system, CO_2 ,N_2 purging system , H_2 Filling system inclusive of all accessories as driers, LLD racks, skids etc.	10%
9	Final Bolt stretching of Generator Base plates and Exciter and Grouting	5%
10	Final Gas Tightness Test of Stator with complete system and Helium Leakage test	5%
11	Assembly of Terminal Bushings in terminal box and electrical checks of stator and rotor before rotor Insertion	2%
	Sub- Total for Turbo Generator	**85%**
D	**PUMPS & AUXILIARIES (13%)**	
1	Erection/testing, Commissioning of Lube Oil Skid(including MOT), Main Oil Pumps, JOP, EOP, AOP, Oil coolers, Centralized Lube Oil Purification System along with all auxiliaries such as Dirty Oil tank ,Clean Oil tank, waste Oil Tank etc.	16%
2	Erection, Testing, Commissioning of 01 No.'s Motor Driven BFP along with all auxiliaries.	12%
3	Erection, Testing, Commissioning of 02 Nos. Turbine Driven BFP along with all auxiliaries and systems.	30%
4	Erection, Testing, Commissioning etc. of Vacuum Pumps	8%
5	Erection, Testing, Commissioning etc. of ACW, DMCW Pumps, Condensate Transfer Pumps, Drip Pumps and all miscellaneous pumps etc.	9%
6	Erection, Testing, Commissioning etc. of Condensate Extraction Pumps	10%
	Sub-Total for Pumps & Auxiliaries	**85%**
E	**HEATERS & DEAERATORS (10%)**	
1	Erection, testing & commissioning of HP & LP Heaters (outside condenser), with all fittings and Handling system.	30%
2	Erection, testing & commissioning of Gland Steam Condenser, Drain Coolers and flash Boxes, inclusive of insulation, supports.	5%
3	Erection, testing & commissioning of De-aerator, Feed Storage Tank and associated approach platform with ladders etc.	50%
	Sub-Total for Heaters & Deaerators	**85%**

F	**MISCELLANEOUS ITEMS (7%)**	
1	Erection, welding and NDT of BF valves, Metallic expansion Joints of TD BFP exhaust ,Enclosures etc.	**8%**
2	Complete Erection, welding, NDT of CW BF Valves, RE Joints, Debris Filters, H&S of CW, Blanks and Tie rod arrangements	**15%**
3	Erection, testing & commissioning of NaoH dosing skids, Seal oil skid, CO2/H2 CYLIDER RACKS ETC	**4%**
4	Erection, testing & commissioning of Flash Tanks, TG Enclosures and all balance Miscellaneous tanks and skids of TG scope.	**10%**
5	Erection, testing & commissioning of Plate Heat Exchanger Package, Self-Cleaning Strainer Package and all other suction, conical strainers.	**10%**
6	Erection, testing & commissioning of Condenser on Load Tube Cleaning Package	**4%**
7	Erection, welding, NDT & commissioning of HP Bypass Valve, HP control Unit including all accessories	**10%**
8	Erection, testing & commissioning of electric hoists, Chain Pulley Blocks (Mech. & Electrical), Mono-Rails of the equipment & other BOIs.	**4%**
9	Erection, Commissioning and Testing of 3X1500 KVA DG Sets	**16%**
10	Erection of approach platforms (For Fabricated platforms, if any, from free issued Materials from BHEL site). MU supplied platforms are to be erected with the equipment within the respective BBU item	**4%**
	Sub-Total for Misc. Items	**85%**
G	**INTEGRAL PIPING (14%)**	
1	Turbine Integral Piping and Generator Integral and Package Piping consisting of Lube Oil, Jacking oil, Oil vapour extraction, Control oil, Seal Oil system, seal steam, Condensate spray /Exhaust Hood Spray, Turbine water drainage etc. complete in all respects, including all accessories like thermo-wells, probes, orifices etc. and hangers and supports (Erection and commissioning on pro-rata basis)	**85%**
	Total for Integral Piping	**85%**
	NOTES:	
	* The payment for 2 Nos. Condensers and 02 Nos. LP Turbines will be divided equally.	

I (b).Payment terms for piping & Insulation (85% of Rate schedules for Item no. A.2, A.3, A.4 & A.5 of the rate schedule, Annexure- II of the TCC**)**

SL NO	**Contract (Main Package) Identification ----->**	**PIPING & VALVES (Item Nos. A.2, A.3 & A.4)**		**INSULATION (Item No.A.5 of rate schedule)**
	Rate schedule Identification ------->	**HP, LP, SS Piping.** **Any Balance piping except temporary**	**Temporary** **Piping for Steam** **Blowing and Chemical Cleaning** **(To be paid under LP Piping)**	**Insulation (including Fixing Components ,Mineral Wool, Sealing Compound, Aluminium sheeting ,Ancillary Material)**
1.1	ON PRE-ASSEMBLY WHEREVER APPLICABLE (IF NOT APPLICABLE, THIS PORTION SHALL BE CLUBBED WITH PLACEMENT IN POSITION)	15	-	--
1.2	PLACEMENT IN POSITION	20	-	50
1.3	ALIGNMENT	15	-	15
1.4	WELDING/BOLTING/FIXING/ GROUTING	20	-	
1.5	ALUMINIUM SHEETING/ CLADDING WITH SEALING COMPOUND	-	-	20

1.6	COMPLETION OF NON DESTRUCTIVE EXAMINATION & STRESS RELIEVING/ HEAT TREATMENT (if not applicable, then this portion to be paid along with welding)	5	-	--
1.7	INSTALLATION OF TEMPORARY PIPING	-	60	-
1.8	DISMANTLING OF TEMPORARY PIPING, EDGE PREPARATION AND RETURN TO BHEL STORES	-	25	-
1.9	HANGERS & SUPPORTS ETC WHEREVER NECESSARY	5	-	--
1.10	HYDRAULIC TEST OR PNEUMATIC TEST	3	-	-
1.11	FLOATING OF LINES, FINAL ADJUSTMENT OF SUPPORTS FOR COLD AND HOT VALUES (if not applicable, this portion to be clubbed along with hydraulic test/pneumatic test)	2	-	
	TOTAL FOR PRO RATA PAYMENTS (TOTAL%)	**85**	**85**	**85**

II. Stage/Milestone Payments (15%) of the CV

H	Milestone/ Stage	15% of Lumpsum Scope (Rate schedule Item No. A.1)	15% of Rate schedule Item No. A.2,A.3 and A.4 (HP, LP, SS Piping Temporary Piping, Balance piping , if any shall be covered under LP piping rate schedule)	15% of Rate schedule Item No. A.5 Insulation (including Fixing Components ,Mineral Wool, Sealing Compound, Aluminium sheeting ,Ancillary Material)
1	Oil Flushing (TG)	1%	-	-
2	Barring Gear (TG)	1%	-	-
3	Rolling & Synchronization	2%	2%	2%
4	Full Load	2%	2%	2%
5	Initial/Trial Operation of unit	2%	2%	2%
6	Alkali/Detergent Flushing		1%	1%
7	Steam Blowing		1%	1%
8	Painting (including arrow marking, nomenclature etc.)	3%	3%	3%
9	Area cleaning, temp. structure cutting/removal and return of scrap	1%	1%	1%
10	Punch list points/ pending points liquidation	1%	1%	1%
11	Material Reconciliation	1%	1%	1%

H	Milestone/ Stage	15% of Lumpsum Scope (Rate schedule Item No. A.1)	15% of Rate schedule Item No. A.2,A.3 and A.4 (HP, LP, SS Piping Temporary Piping, Balance piping , if any shall be covered under LP piping rate schedule)	15% of Rate schedule Item No. A.5 Insulation (including Fixing Components ,Mineral Wool, Sealing Compound, Aluminium sheeting ,Ancillary Material)
12	Completion of contractual obligations	1%	1%	1%
	Total for Milestone/Stage payments (%)	**15%**	**15%**	**15%**

Common Notes for Payment terms:

1. The Terms of payment is only for enabling release of payments through RABs and is not indicative of the actual quantum or value of work

2. If the commissioning activities could not be carried out due to no fault of contractor, BHEL Site in-charge, at his discretion, after recording reasons for exercising such option, can split and release payment up to 50% of milestone payment on completion of work, to the extent possible, required for carrying out that particular milestone/ commissioning activity.

3. In line with GCC clause 2.23.1.(v) to facilitate part payment, BHEL Site Engineer at his discretion may further split the contracted rates/percentages to suit site conditions, cash flow requirements according to the progress of work.

8.0	**TAXES & DUTIES**
8.1	The contractor shall pay all (save the specific exclusions as enumerated in this clause) taxes, fees, license, charges, deposits, duties, tools, royalty, commissions, other charges, etc. which may be levied on the input goods & services consumed and output goods & services delivered in course of his operations in executing the contract. In case BHEL is forced to pay any of such taxes/duties, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit. However, provisions regarding **GST** on output supply (goods/service) and TDS/TCS as per Income Tax Act shall be as per following clauses.
8.2	**GST (Goods and Services Tax)**
8.2.1	GST as applicable on output supply (goods/services) are excluded from contractor's scope; therefore, contractor's price/rates shall be **exclusive** of GST. Reimbursement of GST is subject to compliance of following terms and conditions. BHEL shall have the right to deny payment of GST and to recover any loss to BHEL on account of tax, interest, penalty etc. for non-compliance of any of the following condition.
8.2.2	The admissibility of GST, taxes and duties referred in this chapter or elsewhere in the contract shall be limited to direct transactions between BHEL & its Contractor. BHEL shall not consider GST on any transaction other than the direct transaction between BHEL & its Contractor.
8.2.3	Contractor shall obtain prior written consent of BHEL before billing the amount towards such taxes. Where the GST laws permit more than one option or methodology for discharging the liability of tax/levy/duty, BHEL shall have the right to adopt the appropriate one considering the amount of tax liability on BHEL/Client as well as procedural simplicity with regard to assessment of the liability. The option chosen by BHEL shall be binding on the Contractor for discharging the obligation of BHEL in respect of the tax liability to the Contractor.
8.2.4	Contractor has to submit GST registration certificate of the concerned state. Contractor also needs to ensure that the submitted GST registration certificate should be in active status during the entire contract period.
8.2.5	Contractor/Vendor has to issue invoice indicating HSN/SAC code, Description, Value, Rate, applicable tax and other particulars in compliance with the provisions of relevant GST Act and Rules made thereunder.
8.2.6	Vendor has to submit GST compliant invoice within seven days from the due date of invoice as per GST Law. In case of delay, BHEL reserves the right of denial of GST payment if there occurs any hardship to BHEL in claiming the input thereof. In case of goods, vendor has to provide scan copy of invoice & GR/LR/RR to BHEL before movement of goods starts. Special care should be taken in case of month end transactions.

8.2.7	Vendor has to ensure that invoice in respect of such services which have been provided/completed on or before end of the month should not bear the date later than last working day of the month in which services are performed.
8.2.8	Subject to other provisions of the contract, GST amount claimed in the invoice shall be released on fulfilment of all the following conditions by the Contractor: - a. Supply of goods and/or services have been received by BHEL. b. Original Tax Invoice has been submitted to BHEL. c. Contractor/ Vendor has submitted all the documents required for processing of bill as per contract/ purchase order/ work order. d. In cases where e-invoicing provision is applicable, vendor/contractor is required to submit invoice in compliance with e-invoicing provisions of GST Act and Rules made thereunder. e. Contractor has filed all the relevant GST return (e.g. GSTR-1, GSTR-3B, etc.) pertaining to the invoice submitted and submit the proof of such return along with immediate subsequent invoice. In case of final invoice/ bill, contractor has to submit proof of such return within fifteen days from the due date of relevant return. f. Respective invoice has appeared in BHEL's GSTR - 2A for the month corresponding to the month of invoice. Alternatively, BG of appropriate value may be furnished which shall be valid at least one month beyond the due date of confirmation of relevant payment of GST on GSTN portal or sufficient security is available to adjust the financial impact in case of any default by the contractor. g. Contractor has to submit an undertaking confirming the payment of all due GST in respect of invoices pertaining to BHEL.
8.2.9	Any financial loss arises to BHEL on account of failure or delay in submission of any document as per contract/purchase order/work order at the time of submission of Tax invoice to BHEL, shall be deducted from contractor's bill or otherwise as deemed fit.
8.2.10	TDS as applicable under GST law shall be deducted from contractor's bill.
8.2.11	Contractor shall comply with the provisions of e-way bill wherever applicable. Further wherever provisions of GST Act permits, all the e-way bills , road permits etc. required for transportation of goods needs to be arranged by the contractor.
8.2.12	Contractor shall be solely responsible for discharging his GST liability according to the provisions of GST Law and BHEL will not entertain any claim of GST/interest/penalty or any other liability on account of failure of contractor in complying the provisions of GST Law or discharging the GST liability in a manner laid down thereunder.
8.2.13	In case declaration of any invoice is delayed by the vendor in his GST return or any invoice is subsequently amended/altered/deleted on GSTN portal which results in any adverse financial implication on BHEL, the financial impact thereof including interest/penalty shall be recovered from the Contactor's due payment.

8.2.14	Any denial of input credit to BHEL or arising of any tax liability on BHEL due to non-compliance of GST Law by the Contractor in any manner, will be recovered along with liability on account of interest and penalty (if any) from the payments due to the Contactor.
8.2.15	In the event of any ambiguity in GST law with respect to availability of input credit of GST charged on the invoice raised by the contractor or with respect to any other matter having impact on BHEL, BHEL's decision shall be final and binding on the contractor.
8.2.16	**Variation in Taxes & Duties:** Any upward variation in GST shall be considered for reimbursement provided supply of goods and services are made within schedule date stipulated in the contract or approved extended schedule for the reason solely attributable to BHEL. However downward variation shall be subject to adjustment as per actual GST applicability. In case the Government imposes any new levy/tax on the output service/goods after price bid opening, the same shall be reimbursed by BHEL at actual. The reimbursement under this clause is restricted to the direct transaction between BHEL and its contactor only and within the contractual delivery period only. In case any new tax/levy/duty etc. becomes applicable after the date of Bidder's offer but before opening of the price Bid, the Bidder/Contractor must convey its impact on his price duly substantiated by documentary evidence in support of the same before opening of price bid. Claim for any such impact after opening the price bid will not be considered by BHEL for reimbursement of tax or reassessment of offer.
8.3	**Income Tax:** **TDS/TCS** as applicable under Income Tax Act, 1961 or rules made thereunder shall be deducted/collected from contractor's bill.
8.4	**BUILDING & OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) ACT, 1996 (BOCW Act) AND RULES OF 1998 READ WITH BUILDING & OTHER CONSTRUCTION WORKERS CESS Act, 1996 & CESS RULES, 1998.** In case any portion of work involves execution through building or construction workers, then compliance to the above titled Acts shall be ensured by the contractor and contractor shall obtain license and deposit the cess under the Act. In the circumstances it may be ensured as under:-
8.4.1	It shall be the sole responsibility of the contractor in the capacity of employer to forthwith (within a period of 15 days from the award of work) apply for a license to the Competent Authority under the BOCW Act and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of license / permission to BHEL within a period of one month from the date of award of contract.

8.4.2	It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under these act and rules including that of payment / deposit of 1% cess on gross payment made for value of work involving building or construction workers engaged by the contractor within a period of one month from the receipt of payment.
8.4.3	It shall be the responsibility of the sub-contractor to furnish the receipts /challans towards deposit of the cess together with the number, name and other details of beneficiaries (building workers) engaged by the sub-contractor during the preceding month.
8.4.4	It shall be the absolute responsibility of the sub-contractor to make payment of all statutory payments & compensations to its workers including that is provided under the Workmen's Compensation Act, 1923.
8.4.5	The contractor shall, however ensure before deposit of any BOCW Cess, that customer is not depositing the same in order to avoid excess deposit of cess.
8.4.6	The contractor shall bear cost of BOCW cess either by way of deposit or through recovery by BHEL in case the same is deposited by the customer.
8.4.7	In case of failure in above mentioned compliances, BOCW Cess @ 1% as well as applicable penalty as specified in BOCW Act/Rules shall be deducted from the contractor.
8.4.8	**Notes:** 1) - The Gross amount is to be construed as cost of construction in line with the provisions of the BOCW of the BOCW Cess act and in case of compliance by customer by way of deduction at source in line with clause No 3(2) of the act an equitable adjustment to the relatable cost of construction attributable to the bidder shall be made in terms of clause no. 8.2 of TCC. 2) - In case compliance by customer by way of deduction at source in line with clause no 3(2) is not resorted to, the compliance of BOCW Cess act shall be ensured by the bidder in line with the provisions of BOCW Cess act in terms of clause no 8.2.2 of TCC. 3) - The bidder may consider the cost of construction for levy of BOCW Cess inclusive of GST, however, due to whatsoever reason if the GST does not form the cost of construction for levy of aforesaid Cess an equitable adjustment thereof shall be made to the contract price.

9.1 In order to give Phillip to Pradhan Mantri Kaushal Vikas Yojana:

"The contractor shall, at all stages of work deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/ Industrial Training Institute/ National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/ Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/ semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

ANNEXURE- A

WEIGHT SCHEDULE OF STG & AUXILARIES AT 2X660 MW KHURJA TPS#UNIT 2

SUMMARY OF WEIGHTS

Brief description of Equipment in STG , Auxiliaries and LP,HP Piping Package for Unit#2 at 2x660 MW Khurja STPP		
Sl. No.	**Description**	**Weight (MT)**
A	**Lumpsum scope of the contract**	
1	**Steam Turbine & Aux.**	**1067.00**
2	**Turbo Generator & Aux**	**530.00**
3	**Condenser & Aux**	**888.20**
4	**Heat Exchangers, Pumps and Motors (BFP, CEP, Drip etc.)**	
a	Heaters ,Deaerator & FST - HYD	**739.00**
b	BFP - TD - HYD	**75.20**
c	BFP - MD - HYD	**93.15**
d	CEP - HYD	**98.10**
e	Drip Pump - HYD	**28.60**
f	TDBFP Turbine - HYD	**222.66**
g	Motors - Bhopal (ACW, Etc.)	**7.50**
h	Motors - Bhopal (DMCW - TG & SG)	**7.50**
5	**BOI Items (including turbine integral piping /valves, ME Bellows, PHE, RE Joints, flash tanks, butterfly valves, dosing skids, structural materials etc.)**	
a	Flash Tanks - BPL	**8.88**
b	Misc Tanks - BPL	**12.50**
c	BOIs - HWR	**709.35**
d	RE Joint - Bhopal	**110.00**
e	BFV - Bhopal	**72.41**
f	**BOIs - PEM**	
i	PUMPS HORIZONTAL & ME BELLOWS	**75.00**
ii	BOIs-PEM Others	**79.85**
iii	CHAIN PULLEY BLOCKS	**0.50**
iv	ELECTRIC HOISTS	**7.00**
v	TEMPORARY PLATFORM	**20.00**

vi	LUBE OIL TRANSFER PUMPS	**0.60**
vii	Chemical Dosing - PEM	**1.00**
6	**Erection and commissioning of 3x1500 KVA Emergency DG Sets**	**105.0**
	Total Quantity considered in Lumpsum scope	**4959**
B	**Piping & Insulation scope (Item Rate- Rate per MT)**	
1	**PEM supply insulation material**	**274.00**
2	**(CW +LP+ Temp) Piping including Pipes**	**569.00**
3	**Power Cycle Piping (Including Trichy Valves)**	**1235.00**
4	**SS Piping**	**3.00**
	Total considered in Piping, Valves and Insulation	**2081.00**
	Total (MT) for the package	**7040**

Notes:

1. Weight mentioned in the **Chapter-X** are tentative only and based on the engineering /drawings /documents available as on date of NIT and liable for variation.
2. The contractor is required to erect actual tonnage (irrespective of any variation plus or minus) which may be necessary to complete their work and commissioning the Power Cycle Piping and Auxiliaries in all respects as detailed in tender specifications and as per the drawings/ documents for which payments shall be regulated based on the classification of the system in Part-A (Lump sum) or Part B(Item rate) of the above weight schedule.
3. The contractor undertakes to erect / commission actual quantities as per advice of BHEL Engineer and accordingly the final contract price shall be worked out as a summation of the Lump sum price and on the basis of quantities actually erected at site in case of Part-B and payments will also be regulated for the same.

Details of Major Systems are as follows:

A. Lump sum scope of the contract

A.1 Weight Schedule of Steam Turbine & Aux.

ANNEXURE- A.1

SNO	PKG. NO	DESCRIPTION	PKG SIZE (mm)	NET WT (KG.)
1	75001/1	ARRANGE.OF EMBED(ANCHOR POINT)	2550X800X1000	657
2	75001/2	ARRANGE.OF EMBED(ANCHOR POINT)	2550X800X1000	657
3	75001/3	ARRANGE.OF EMBED(ANCHOR POINT)	2550X800X1000	657
4	75001/4	ARRANGE.OF EMBED(ANCHOR POINT)-ANCHOR BOX TYPE-A	2550X800X1000	657
5	75001/5	ARRANGE.OF EMBED(ANCHOR POINT)	2550X800X1000	657
6	75001/6	ARRANGE.OF EMBED(ANCHOR POINT)	3350X800X1000	825
7	75001/7	ARRANGE.OF EMBED(ANCHOR POINT)-EMBED.FOR LPC GUIDE BOLT	3350X800X1000	993
8	75001/8	ARRANGE.OF EMBED(ANCHOR POINT)-EMBED.FOR LPC GUIDE BOLT	3350X800X1000	993
9	75001/9	ARRANGE.OF EMBED(ANCHOR POINT)-LOOSE ITEMS	1350X1300X1250	640
10	75001/10	ARRANGE.OF EMBED(ANCHOR POINT)-ANCHOR RODS/NUTS	1350X1300X1250	676
11	75001/11	ARRANGE.OF EMBED(ANCHOR POINT)	1350X1300X1250	647
12	75003/1	BASE PLATE ASSEMBLY	1550X900X900	774
13	75003/2	BASE PLATE ASSEMBLY	800X800X800	268
14	75004/0	BASE PLATE ASSEMBLY	3150X1650X850	5128
15	75102/1	CASING UPPER PART	8600X3000X3000	12860
16	75102/2	CASING UPPER PART	7940X2800X2940	12860
17	75103/1	CASING UPPER PART	8600X3000X3000	12170
18	75103/2	CASING UPPER PART	7940X2800X2840	12170
19	75104/0	RUPTURE DIAPHRAGM ASSEMBLY	2800X2400X1600	1824
20	75107/1	CASING SIDE WALL (LEFT)	5330X5040X600	7480
21	75107/2	CASING SIDE WALL (LEFT)	5325X5030X540	7480
22	75108/1	CASING SIDE WALL (RIGHT)	5030X5040X600	7480
23	75108/2	CASING SIDE WALL (RIGHT)	5325X5030X540	7480
24	75109/1	FRONT WALL LP-1(TS)	8000X5040X1200	14657
25	75109/2	FRONT WALL LP-2(TS)	8000X5040X1200	14657
26	75110/1	FRONT WALL LP-1(GS)	8000X5040X1200	14657
27	75110/2	FRONT WALL LP-2(GS)	8000X5040X1200	14657
28	75111/1	LP SHAFT SEAL CASING - TS	2000X1650X750	672

29	75111/2	LP SHAFT SEAL CASING - TS	1850X1600X750	672
30	75112/1	LP SHAFT SEAL CASING - GS	2000X1650X750	672
31	75112/2	LP SHAFT SEAL CASING - GS	2000X1650X750	672
32	75113/1	LP SHAFT SEAL COMPENSATOR (TS)	2250X2200X900	715
33	75113/2	LP SHAFT SEAL COMPENSATOR (TS)	2250X2200X900	715
34	75114/1	LP SHAFT SEAL COMPENSATOR (GS)	2250X2200X900	715
35	75114/2	LP SHAFT SEAL COMPENSATOR (GS)	2250X2200X900	715
37	75116/1	CASING FRAME SECTION	7540X4790X250	6659
38	75116/2	CASING FRAME SECTION	7540X4790X250	6659
39	75116/3	CASING FRAME SECTION	2500X1300X1200	7113
40	75116/4	CASING FRAME SECTION	2350X1350X1750	6133
41	75201/0	HP/IP BEARING PEDESTAL	4420X2523X2171	11800
42	75202/0	HP/IP BEARING PEDESTAL (PARTS)	1200X1000X800	350
53	75315/0	AUXILIARIES OF LP TURBINE	1800X500X600/2100/2000/1500	425
58	75319/4	SPARES OF BLOWOUT & HYDRAULICTEST DEVICE	1400X1400X400	37
65	75401/0	IP-LP BEARING PEDESTAL ASSLY	6850X2660X2494	18000
66	75402/0	BEARING PEDESTAL (PARTS)	2500X1000X600	910
67	75501/0	LP/GEN. PEDESTAL ASSEMBLY	6850X2660X2495	17120
68	75502/0	BEARING PEDESTAL (PARTS)	1600X1000X800	495
69	75503/0	LP/LP PEDESTAL ASSEMBLY	6850X2850X2540	18000
70	75505/0	BEARING PEDESTAL (PARTS)	1600X1000X800	918
71	75601/1	FRONT BEARING PEDESTAL	3450X1935X1623	4619
72	75601/2	HYDRALLIC TURNING MOTOR	1300X900X1000	563
73	75601/3	FRONT BEARING PEDESTALS(PARTS)	1500X1000X600	250
74	75705/1	LP EXTRACTION A1	1140X2050X980	320
75	75705/2	LP EXTRACTION A1	1140X2050X980	320
76	75706/1	LP EXTRACTION A1	1140X2050X980	320
77	75706/2	LP EXTRACTION A1	1140X2050X980	320
78	75707/1	LP EXTRACTION A1	4200X1130X1230	697
79	75707/2	LP EXTRACTION A1	4200X1130X1230	697
80	75707/3	LP EXTRACTION A1	4200X1130X1230	697
81	75707/4	LP EXTRACTION A1	4200X1130X1230	697
82	75708/1	LP EXTRACTION A2	1960X2060X1030	639
83	75708/2	LP EXTRACTION A2	1960X2060X1030	639
84	75709/1	LP EXTRACTION A2	4200X1130X1230	697
85	75709/2	LP EXTRACTION A2	4200X1130X1230	697

86	75710/1	LP EXTRACTION A2	4200X1130X1230	697
87	75710/2	LP EXTRACTION A2	4200X1130X1230	697
88	75711/1	LP EXTRACTION A3	2760X2140X1050	1332
89	75711/2	LP EXTRACTION A3	2740X2600X990	791
90	75712/1	LP EXTRACTION A3	2690X2480X1050	1250
91	75712/2	LP EXTRACTION A4	2770X2140X1100	1332
92	75713/1	LP EXTRACTION A4	2740X2600X990	791
93	75713/2	LP EXTRACTION A4	2690X2480X1050	1250
94	75716/1	EXTRACTION PIPE SHEATHING A3	1300X950X950	464
95	75716/2	EXTRACTION PIPE SHEATHING A3	2700X1050X900	1372
96	75716/3	EXTRACTION PIPE SHEATHING A3	2100X1300X850	618
97	75716/4	EXTRACTION PIPE SHEATHING A3	1950X1000X900	797
98	75716/5	EXTRACTION PIPE SHEATHING A4	1300X950X950	464
99	75716/6	EXTRACTION PIPE SHEATHING A4	2700X1050X900	1372
100	75716/7	EXTRACTION PIPE SHEATHING A4	2100X1300X850	618
101	75716/8	EXTRACTION PIPE SHEATHING A4	1950X1000X900	797
102	75717/0	COMPENSATORS FOR CASING GUIDE	5500X1800X800/950	2200
103	75717/2	COMPENSATORS FOR CASING GUIDE	5500X1800X800/1600/1600/550	430
104	75717/3	COMPENSATORS FOR CASING GUIDE	5500X1800X800/1600/1600/550	430
105	75717/4	COMPENSATORS FOR CASING GUIDE	5500X1800X800/1800/1000/650	918
106	75720/1	LP INNER CASING (U/H)	5210X5230X3625	16495
107	75720/2	LP INNER CASING (U/H)	5210X5230X3625	16495
108	75721/1	LP INNER CASING (L/H)	5770X5490X3676	40211
109	75721/2	LP INNER CASING (L/H)	5770X5490X3676	40211
110	75722/1	ASSEMBLY OF GUIDE BLADECARRIER 3L FOR LPT1(U/H)	4000X2300X1000	3100
111	75722/2	ASSEMBLY OF GUIDE BLADECARRIER 3R FOR LPT1(U/H)	4000X2300X1000	3100
112	75722/3	ASSEMBLY OF GUIDE BLADECARRIER 3L FOR LPT2(U/H)	4000X2300X1000	3100
113	75722/4	ASSEMBLY OF GUIDE BLADECARRIER 3R FOR LPT2(U/H)	4000X2300X1000	3100
114	75722/5	ASSEMBLY OF GUIDE BLADECARRIER LPT1 (L) (U/H)	3400X1600X1600	6765
115	75722/6	ASSEMBLY OF GUIDE BLADECARRIER LPT1 (R) (U/H)	3400X1600X1600	6765
116	75722/7	ASSEMBLY OF GUIDE BLADECARRIER LPT2 (L) (U/H)	3400X1600X1600	6765
117	75722/8	ASSEMBLY OF GUIDE BLADECARRIER LPT2 (R) (U/H)	3400X1600X1600	7000
118	75723/1	LP CASING ASSEMBLY PARTS	4800X700X700	892
119	75723/2	LP CASING ASSEMBLY PARTS	1300X900X900	640

120	75723/3	LP CASING ASSEMBLY PARTSLP CASING ASSEMBLY PARTS	600X500X400	12
121	75723/4	LP CASING ASSEMBLY PARTS	700X500X500	112
122	75723/5	LP CASING ASSEMBLY PARTS	2100X2100X800	1192
123	75724/1	LP INNER CASING ASSEMBLY(PARTS	3250X1600X600	1020
124	75724/2	LP INNER CASING ASSEMBLY(PARTS	3250X1600X600/3400/1800/500	1020
125	75801/1	LP ROTOR	6375X3740X3740	59000
126	75801/2	LP ROTOR	6375X3740X3740	59000
127	75901/0	IP ROTOR	6190X1900X2035	27400
128	75902/0	IP OUTER CASING (U/H)	6240X4200X2427	29000
129	75903/0	IP OUTER CASING (L/H)	5945X4200X2325	38200
130	75904/0	IP INNER CASING (U/H)	4165X4422X2418	26723
131	75905/0	IP INNER CASING(L/H)	4422X4165X2418	31000
132	75906/0	SUPPORTING ARMS-IP OUTERCASING	1500X1300X900	1909
133	75907/0	IP SHAFT SEALING	1000X500X500	533
134	75908/0	IP TURBINE (PARTS)	3000X2500X1600	6900
135	75909/0	I.P. TURBINE PARTS	1300X1300X500	75
136	76001/0	HP TURBINE	6745X3790X3495/6745X3810X3495	125339
137	76002/0	HP INLET ASSEMBLY	1200X800X500	120
138	76004/0	HP TURBINE PARTS	650X400X400	50
139	76104/0	ESV & CV CASING WITH VALVES	5100X4800X3100/5005X5500X3640	38590
140	76105/1	MOUNTING SUPPORT FOR MS VALVE	1700X800X1000	895
141	76105/2	MOUNTING SUPPORT FOR MS VALVE	1700X800X1000	895
142	76108/0	ESV & CV CASING WITH VALVES	5100X4800X3100/5005X5500X3640	38590
143	76112/0	OVERLOAD VALVE CASINGWITH VALVE	3000X2000X1400	3041
144	76201/0	SUSPENSION OF OVERLOAD VALVE	1300X950X1100/3850X700X1200	800
145	76202/0	IV & CV CASING WITH VALVES	6370X5600X3600	41862
146	76202/1	PARTS OF IV&CV CASING	1800X1000X200	88
147	76205/1	MOUNTING SUPPORT FOR HRH VALVE	2750X1800X900	2450
148	76205/2	MOUNTING SUPPORT FOR HRH VALVE	2750X1800X900	2450
149	76206/0	IV & CV CASING WITH VALVES	6370X5600X3600	41862
150	76206/1	PARTS OF IV&CV CASING	1800X1000X200	88
151	76301/1	SUSPENSION OF LPBP VALVE	3600X700X700	720
152	76301/2	SUSPENSION OF LPBP VALVE	3600X700X700	720
153	76412/0	LEAKAGE OIL TANK	1000X1000X3000	515
154	76413/0	WASTE OIL TANK	1000X1000X3000	515
155	76601/0	COMPONENTS OF COP ASSEMBLY	2600X2200X1900	1966

156	76602/0	COMPONENTS OF COP ASSEMBLY	2500X2800X1600	1858
157	76603/0	COMPONENTS OF COP ASSEMBLY	2600X2800X2800	5945
158	76604/0	COMPONENTS OF COP ASSEMBLY	5700X2600X1950	10354
159	76605/0	COMPONENTS OF COP ASSEMBLY	6000X2600X1950	10573
160	76606/0	COMPONENTS OF COP ASSEMBLY	1700X1700X1200/3400/1700/1200	2064
161	76607/0	COMPONENTS OF COP ASSEMBLY	1700X1700X1200/4600X2300X1600	4462
162	76608/0	COMPONENTS OF COP ASSEMBLY(PARTS)	1700X1700X1200	6320
163	76801/0	RATING,COLLABORATION ANDCOMPANY'S MONOGRAM	850X550X200	36
164	76914/0	COMPENSATOR	600X600X900	27
165	76921/0	VALVE BLOCK ASSLY	250X200X200	8
Total weight				**1066558**

A.2) Weight Schedule Turbo Generators & Aux.

Annexure A.2

SNO	PKG.	DESCRIPTION	PKG SIZE	NET WT(KG.)
1	601/0	FOUNDATION PLATES	6600X1680X950	9985
2	602/0	FOUNDATION BOLTS	2540X600X655	760
3	603/0	FOUNDATION ITEMS	5800X1120X630	1670
4	605/0	GENERATOR STATOR	9860X4440X4260	292000
5	606/0	GENERATOR ROTOR	14140X1790X1760	76558
7	607/0	END SHIELD LOWER HALF (TE)	3800X1500X2240	8250
8	608/0	END SHIELD UPPER HALF (TE)	3800X1500X2240	7250
9	609/0	END SHIELD LOWER HALF (EE)	3800X1500X2240	8300
10	610/0	END SHIELD UPPER HALF (EE)	3800X1500X2240	7300
11	611/0	GENERATOR BEARING (EE & TE)	1240X1050X1225	1696
12	612/0	BAFFLE RING CARRIER &AIR GAP SEAL ASSY.	2035X1885X1380	919
13	613/0	TERMINAL BUSHINGS	1984X1856X680	1160
14	614/0	TERMINAL BUSHING BOX	3500X2600X1740	5302
15	615/0	SHAFT SEALS (EE & TE) &OIL CATCHER (INNER & OUTER)	2160X2160X730	1030
16	616/0	BAFFLE RING ASSY	1950X1950X1215	738
17	617/0	GENERATOR ACCESSORIES	2200X2200X975	370
18	618/0	FLEXIBLE TERMINAL CONNECTIONS	1420X1020X540	492
19	619/0	GENERATOR ACCESSORIES	1210X1010X400	500

20	620/0	GENERATOR ACCESSORIES	1200X1010X820	760
21	621/0	GENERATOR ACCESSORIES	1710X1220X420	85
22	622/0	PRIMARY WATER TANK	11000X2400X1565	2659
23	624/0	PW TANK PIPE LINES	1200X600X715	100
24	625/0	PLATFORM FOR PW TANK	5000X1200X765	789
25	626/0	COOLER HOUSING FRAME	4290X4450X1428	19992
26	627/0	SEAL RINGS	830X830X315	60
27	628/0	CONNECTION PIECE ASSEMBLY	1880X1300X597	708
28	630/0	GENERATOR-TERMINAL BOXES	1210X1010X800	100
29	631/0	DRY AIR BLOWER	1360X1190X1625	115
35	637/0	BRUSHLESS EXCITER SET	5900X2435X2910	26930
36	639/0	DRY AIR BLOWER AND ACCESSORIES	1800X1500X1258	392
37	640/0	EXCITER BED PLATE ACCESSORIES	4500X1200X1408	1752
38	642/0	EXCITER ACCESSORIES	2200X2100X838	600
39	643/0	EXCITER FOUNDATION ACCESSORIES	1150X750X988	440
40	644/0	RR WHEEL AIR GUIDE COVER	2300X2200X2088	1980
41	645/0	SEAL OIL STORAGE TANK	5124X2140X2165	1945
42	646/0	PW COOLER AND FILTER UNIT	5400X4400X3500	6358
43	648/1	SINGLE FLOW S.O.U.-PART I	3800X2500X2165	2600
44	648/2	SINGLE FLOW S.O.U. -PART II	3270X2440X3650	1300
45	649/0	LIQUID DETECTOR RACK	2132X840X2340	262
46	650/0	GAS UNIT	2550X1750X2725	897
47	651/0	CO2 VAPOURISER	1800X880X900	236
48	652/0	H2 DISTRIBUTOR	3750X1800X840	173
49	653/0	CO2 DISTRIBUTOR	4900X1200X665	140
50	654/0	N2 DISTRIBUTOR	1400X1200X665	55
51	655/0	DRAIN OIL COLLECTOR	2000X550X715	89
52	656/0	RESINS	1200X600X715	56
53	657/0	TG SYSTEM INTEGRAL PIPING(VALVES)	2750X1400X1565	1595
54	659/0	CONSUMABLES	1200X600X720	40
55	667/0	TG SYSTEM INTEGRAL PIPING(HANGER & SUPPORTS)	6340X1640X1245	3010
56	668/0	TG SYSTEM INTEGRAL PIPING(PIPES)	7160X1160X1645	5390

57	669/0	TG SYSTEM INTEGRAL PIPING(PIPES)	7160X1160X1645	5390
58	670/0	TG SYSTEM INTEGRAL PIPING(PIPES)	7160X1160X1645	5390
59	671/0	TG SYSTEM INTEGRAL PIPING(PIPES)	7160X1160X1645	5390
60	672/0	TG SYSTEM INTEGRAL PIPING(I/O HEADER)	2740X2540X1445	1100
61	673/0	TG SYSTEM INTEGRAL IPING(ACCESSORIES -1)	3840X1840X1545	3000
62	674/0	TG SYSTEM INTEGRAL PIPING(ACCESSORIES -2)	1640X1140X745	2000
63	675/0	TG SYSTEM INTEGRAL PIPING(ACCESSORIES -3)	2150X1650X1250	1300
64	676/0	TG SYSTEM INTEGRAL PIPING(ACCESSORIES -4)	1140X1140X745	550
Total Weight				**530008**

A.3) Weight Schedule of Condenser & Aux.

Annexure A.3

SNO	PKG. NO	DESCRIPTION	PKG SIZE	NET WT (KG.)
1	78001/1	HOTWELL - I (CONDENSER-1)	10178X2952X1420	7952
2	78001/2	HOTWELL - II (CONDENSER-2)	10178X2672X1420	7947
3	78004/1	FRONT END BOTTOM PLATE	7860X2380X1129	6250
4	78004/2	FRONT END BOTTOM PLATE	7860X2380X1129	6250
5	78005/1	REAR END BOTTOM PLATE	7860X2380X1247	6537
6	78005/2	REAR END BOTTOM PLATE	7860X2380X1247	6537
7	78006/1	MIDDLE BOTTOM PLATE-1	7860X3700X1036	9219
8	78006/2	MIDDLE BOTTOM PLATE-1	7860X3700X1036	9219
9	78007/1	MIDDLE BOTTOM PLATE-2	7860X1840X1050	4678
10	78007/2	MIDDLE BOTTOM PLATE-2	7860X1840X1050	4678
11	78008/1	MIDDLE BOTTOM PLATE-3	7860X3700X1084	9388
12	78008/2	MIDDLE BOTTOM PLATE-3	7860X3700X1084	9388
13	78010/1	BOTTOM PLATE (LOOSE ITEMS)	950X450X400	232
14	78010/2	BOTTOM PLATE (LOOSE ITEMS)	950X450X400	232

15	78014/1	LOOSE ITEMS (COND.SUPPORT)	3000X1100X1100	1680
16	78014/2	LOOSE ITEMS (COND. SUPPORT)	4000X1200X1200	3050
17	78018/1	LOOSE ITEMS(COND. SUPPORT)	1750X1000X900	1385
18	78018/2	LOOSE ITEMS(COND SUPPORT)	1750X1000X900	1385
19	78019/1	LOOSE ITEMS(COND SUPPORT)	1300X1300X950	3572
20	78019/2	EARTH QUAKE PROTECTION DEVICE	1300X1300X950	3572
21	78021/1	FRONT WATER BOX AND WATERCHAMBER(GEN.SIDE)	6886X4030X4100	29118
22	78021/2	FRONT WATER BOX AND WATERCHAMBER (GEN.SIDE)	6886X4030X4100	29118
23	78024/1	FRONT WATER BOX AND WATERCHAMBER (TUR.SIDE)	6886X4030X4100	29669
24	78024/2	FRONT WATER BOX AND WATERCHAMBER (TUR.SIDE)	6886X4030X4100	29669
25	78027/1	REAR WATER BOX AND WATERCHAMBER (GEN.SIDE)	7014X4030X3475	27652
26	78027/2	REAR WATER BOX AND WATERCHAMBER (GEN.SIDE)	7014X4030X3475	27652
27	78030/1	REAR WATER BOX AND WATERCHAMBER (TUR.SIDE)	7014X4030X3475	27652
28	78030/2	REAR WATER BOX AND WATERCHAMBER (TUR.SIDE)	7014X4030X3475	27652
29	78032/1	SIDE WALL(TUR.END-PLATES)CONDENSER-1	6930X1865X40	3770
30	78032/2	SIDE WALL(TUR.END-PLATES)CONDENSER-2	6930X1865X40	3770
31	78033/1	SIDE WALL(TUR.END-PLATES)CONDENSER-1	6930X2480X80	10792
32	78033/2	SIDE WALL(TUR.END-PLATES)CONDENSER-2	6930X2480X80	10792
33	78034/1	SIDE WALL(TUR.END-LOOSE ITEMS)CONDENSER-1	4750X450X350	588
34	78034/2	SIDE WALL(TUR.END-LOOSE ITEMS)CONDENSER-2	4750X450X350	588
35	78041/1	SIDE WALL(GEN.END-PLATES)CONDENSER-1	6930X1865X40	3770
36	78041/2	SIDE WALL(GEN.END-PLATES)CONDENSER-2	6930X1865X40	3770
37	78042/1	SIDE WALL(GEN.END-PLATES)CONDENSER-1	6930X2480X80	10792
38	78042/2	SIDE WALL(GEN.END-PLATES)CONDENSER-2	6930X2480X80	10792
39	78046/1	SIDE WALL(GEN.END-LOOSE ITEMS)CONDENSER-1	4750X450X350	588
40	78046/2	SIDE WALL(GEN.END-LOOSE ITEMS)CONDENSER-2	4750X450X350	588
41	78047/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
42	78047/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240

43	78048/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
44	78048/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
45	78049/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
46	78049/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
47	78050/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
48	78050/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
49	78051/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
50	78051/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3240
51	78052/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3564
52	78052/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3564
53	78053/1	SHELL INTERNAL STIFFENING RODS	6610X750X410	3564
54	78053/2	SHELL INTERNAL STIFFENING RODS	6610X750X410	3564
55	78054/1	SHELL INTERNAL STIFFENING RODS	1000X800X600	837
56	78054/2	SHELL INTERNAL STIFFENING RODS	1000X800X600	837
57	78055/1	SHELL INTERNAL STIFFENING RODS	3700X850X700	2117
58	78055/2	SHELL INTERNAL STIFFENING RODS	3700X850X700	2117
59	78056/1	SHELL INTERNAL STIFFENING RODS	3700X850X700	2117
60	78056/2	SHELL INTERNAL STIFFENING RODS	3700X850X700	2117
61	78057/1	SHELL INTERNAL STIFFENING RODS	3700X850X700	2117
62	78057/2	SHELL INTERNAL STIFFENING RODS	3700X850X700	2117
63	78058/1	AIR EXTRACTION PIPINGCONDENSER-1	5600X1100X1100	1929
64	78058/2	AIR EXTRACTION PIPINGCONDENSER-2	5600X1100X1100	1929
65	78059/1	TUBE SUPPORT PLATE	5800X3820X183	5856
66	78059/2	TUBE SUPPORT PLATE	5800X3820X183	5856
67	78060/1	TUBE SUPPORT PLATE	5800X3820X183	5856
68	78060/2	TUBE SUPPORT PLATE	5800X3820X183	5856
69	78061/1	TUBE SUPPORT PLATE	5800X3820X170	4392
70	78061/2	TUBE SUPPORT PLATE	5800X3820X170	4392
71	78062/1	TUBE SUPPORT PLATE	5800X3820X170	4392
72	78062/2	TUBE SUPPORT PLATE	5800X3820X170	4392
73	78063/1	TUBE SUPPORT PLATE	5800X3820X170	4392
74	78063/2	TUBE SUPPORT PLATE	5800X3820X170	4392
75	78064/1	TUBE SUPPORT PLATE	5800X3820X170	4392
76	78064/2	TUBE SUPPORT PLATE	5800X3820X170	4392
77	78065/1	TUBE SUPPORT PLATE	5800X3820X170	4392

78	78065/2	TUBE SUPPORT PLATE	5800X3820X170	4392
79	78066/1	TUBE SUPPORT PLATE	5800X3820X170	4392
80	78066/2	TUBE SUPPORT PLATE	5800X3820X170	4392
81	78067/1	TUBE SUPPORT PLATE	5800X3820X170	4392
82	78067/2	TUBE SUPPORT PLATE	5800X3820X170	4392
83	78068/1	TUBE SUPPORT PLATE	5800X3820X170	4392
84	78068/2	TUBE SUPPORT PLATE	5800X3820X170	4392
85	78069/1	SHELL INTERNAL DETAILS	1700X900X1000	3202
86	78069/2	SHELL INTERNAL DETAILS	1700X900X1000	3202
87	78070/1	SHELL INTERNAL DETAILS	6000X900X900	4030
88	78070/2	SHELL INTERNAL DETAILS	6000X900X900	4030
89	78071/1	SHELL INTERNAL DETAILS	1300X1200X900	2387
90	78071/2	SHELL INTERNAL DETAILS	1300X1200X900	2387
91	78072/1	SHELL INTERNAL DETAILS	1000X1000X800	1426
92	78072/2	SHELL INTERNAL DETAILS	1000X1000X800	1426
93	78074/1	LOWER DOME WALL(TS)CONDENSER-1	6750X2941X185	4793
94	78074/2	LOWER DOME WALL(TS)CONDENSER-2	6691X3478X865	5582
95	78075/1	LOWER DOME WALL(TS)(CONDENSER-1)	6690X2941X185	4797
96	78075/2	LOWER DOME WALL(TS)(CONDENSER-2)	6750X3478X850	5640
97	78076/1	LOWER DOME WALL(TS)CONDENSER-1	4150X450X300	1070
98	78076/2	LOWER DOME WALL(TS)CONDENSER-2	5067X2730X510	3586
99	78077/1	LOWER DOME WALL(TS)CONDENSER-1	2900X2570X180	1240
100	78077/2	LOWER DOME WALL(TS)CONDENSER-2	5095X2730X750	3490
101	78101/1	LOWER DOME WALL(GS)CONDENSER-1	6750X3478X480	5702
102	78101/2	LOWER DOME WALL(GS)CONDENSER-2	6690X2950X180	4760
103	78102/1	LOWER DOME WALL(GS)CONDENSER-1	6691X3478X750	5650
104	78102/2	LOWER DOME WALL(GS)CONDENSER-2	6750X2941X180	4797
105	78103/1	LOWER DOME WALL (GS)CONDENSER-1	5093X2730X250	3560
106	78103/2	LOWER DOME WALL (GS)CONDENSER-2	8000X3000X650	10550
107	78104/1	LOWER DOME WALL(GS)CONDENSER-1	5087X2730X250	3550
108	78104/2	LOWER DOME WALL(GS)CONDENSER-2	2428X3000X180	1250
109	78105/1	LOWER DIME WALL LOOSE ITEMSCONDENSER-1	7250X1826X600	3808
110	78105/2	LOWER DOME WALL LOOSE ITEMSCONDENSER-2	8492X300X50	640

111	78107/1	LOOSE ITEM L D WALL (FWB)CONDENSER-1	2850X2000X400	1785
112	78107/2	LOOSE ITEM L D WALL (FWB)CONDENSER-2	2850X2000X400	1785
113	78108/1	LOWER DOME WALL(FWB)CONDENSER-1	7266X2870X950	4618
114	78108/2	LOWER DOME WALL (FWB)CONDENSER-2	7266X2870X950	4618
115	78109/1	LOWER DOME WALL (FWB)CONDENSER-1	6412X2430X220	3700
116	78109/2	LOWER DOME WALL (FWB)CONDENSER-2	6412X2430X220	3700
117	78110/1	LOWER DOME WALL(FWB)CONDENSER-1	5615X300X180	403
118	78110/2	LOWER DOME WALL (FWB)CONDENSER-2	5615X300X220	403
119	78112/1	LOOSE ITEMSLOWER DOME WALL (FWB) COND.-1	750X500X350	35
120	78112/2	LOOSE ITEMSLOWER DOME WALL (FWB) COND.-2	750X400X400	30
121	78113/1	LOWER DOME WALL(RWB)(CONDENSER-1)	7900X1639X500	3506
122	78113/2	LOWER DOME WALL(RWB)(CONDENSER-2)	7900X1639X220	3506
123	78114/1	LOWER DOME WALL(RWB)(CONDENSER-1)	7290X3400X1950	5400
124	78114/2	LOWER DOME WALL(RWB)(CONDENSER-2)	7290X3400X1950	5400
125	78115/1	LOWER DOME WALL(RWB)CONDENSER-1	6025X1400X930	2780
126	78115/2	LOWER DOME WALL(RWB)CONDENSER-2	6025X1400X930	2780
127	78116/1	LOWER DOME WALL(RWB)CONDENSER-1	7900X1730X380	3615
128	78116/2	LOWER DOME WALL(RWB)CONDENSER-2	7900X1730X380	3615
129	78118/1	LOOSE ITEMSLOWER DOME WALL (RWB) COND.-1	2100X2100X2200	1305
130	78118/2	LOOSE ITEMSLOWER DOME WALL (RWB) COND.-2	2100X2100X2200	1305
131	78121/1	DOME INTERNAL STIFFENINGCONDNSER-1	5350X1750X950	5556
132	78121/2	DOME INTERNAL STIFFENINGCONDENSER-2	5350X1750X950	5556
133	78122/1	DOME INTERNAL STIFFENINGCONDENSER-1	3300X1350X1200	3759
134	78122/2	DOME INTERNAL STIFFENINGCONDENSER-2	3300X1350X1200	3759
135	78123/1	DOME INTERNAL STIFFENINGCONDENSER-1	2900X1100X1450	3241
136	78123/2	DOME INTERNAL STIFFENINGCONDENSER-2	2900X1100X1450	3241
137	78124/1	DOME INTERNAL STIFFENINGCONDENSER-1	2200X1900X1300	2564
138	78124/2	DOME INTERNAL STIFFENINGCONDENSER-2	2200X1900X1300	2564
139	78125/1	DOME INTERNAL STIFFENINGCONDENSER-1	2900X1500X1800	6010
140	78125/2	DOME INTERNAL STIFFENINGCONDENSER-2	2900X1500X1800	6010
141	78126/1	DOME INTERNAL STIFFENINGCONDENSER-1	1800X1100X1400	1845
142	78126/2	DOME INTERNAL STIFFENINGCONDENSER-2	1800X1100X1400	1849
143	78127/1	LOOSE ITEMS DOME INTERNALSTIFFENING COND.-1	3300X460X460	485

144	78127/2	LOOSE ITEMS DOME INTERNALSTIFFENING COND.-2	3300X460X460	485
145	78129/1	LP HEATER SUPPORT ARRANGEMENTLOOSE ITEMS	1750X900X900	935
146	78129/2	LP HEATER SUPPORT ARRANGEMENTLOOSE ITEMS	1750X900X900	935
147	78130/1	LP HEATER SUPPORT ARRANGEMENTLOOSE ITEMS	6500X1600X750	4281
148	78130/2	LP HEATER SUPPORT ARRANGEMENTLOOSE ITEMS	6500X1600X750	4281
149	78132/1	UPPER DOME WALL (TURBINE SIDE)CONDENSER-1	7632X650X300	1611
150	78132/2	UPPER DOME WALL (TURBINE SIDE)CONDENSER-2	7632X650X300	1611
151	78133/1	UPPER DOME WALL(GEN SIDE)CONDENSER-1	7632X650X300	1611
152	78133/2	UPPER DOME WALL(GEN SIDE)CONDENSER-2	7632X650X300	1611
153	78136/1	UPPER DOME WALL (FWB)CONDENSER-1	5494X650X300	1028
154	78136/2	UPPER DOME WALL (FWB)CONDENSER-2	5494X650X300	1325
155	78137/1	UPPER DOME WALL(RWB)CONDENSER-1	5494X650X300	1325
156	78137/2	UPPER DOME WALL(RWB)CONDENSER-2	5494X650X300	1325
157	78142/1	FRONT W/BOX HINGE ARRANGEMENT	2400X1300X1200	6234
158	78142/2	FRONT W/BOX HINGE ARRANGEMENT	2400X1200X800	2704
159	78143/1	REAR W/BOX HINGE ARRANGEMENT	1800X900X1200	2948
160	78143/2	REAR W/BOX HINGE ARRANGEMENT	1800X900X800	1208
161	78144/1	FRONT W/BOX HINGE ARRANGEMENT	850X850X600	318
162	78144/2	FRONT W/BOX HINGE ARRANGEMENT	850X850X600	318
163	78145/1	REAR W/BOX HINGE ARRANGEMENT	850X850X600	318
164	78145/2	REAR W/BOX HINGE ARRANGEMENT	850X850X600	318
165	78146/1	FRONT W/BOX HINGE ARRANGEMENT	2400X700X400	552
166	78146/2	FRONT W/BOX HINGE ARRANGEMENT	2400X700X400	552
167	78147/1	REAR W/BOX HINGE ARRANGEMENT	2400X700X400	552
168	78147/2	REAR W/BOX HINGE ARRANGEMENT	2400X700X400	552
169	78150/1	FRONT W/BOX HINGE ARRANGEMENT	1498X1240X400	1164
170	78150/2	FRONT W/BOX HINGE ARRANGEMENT	1498X1240X400	1164
171	78151/1	REAR W/BOX HINGE ARRANGEMENT	1492X1140X400	902
172	78151/2	REAR W/BOX HINGE ARRANGEMENT	1492X1140X400	902
173	78157/1	CONDENSER (LOOSE ITEMS)	1000X800X800	200
174	78157/2	CONDENSER (LOOSE ITEMS)	1000X800X800	200
175	78158/1	COND. LOOSE ITEMS (RUBBER CORD FOR BOTH CONDENSER)	1000X800X800	200

176	78158/2	COND. LOOSE ITEMS (RUBBER CORD FOR BOTH CONDENSER)	1000X800X800	200
177	78159/1	FASTENERS (CONDENSER)	1500X1300X1300	2300
178	78159/2	FASTENERS (CONDENSER)	1500X1300X1300	2300
179	78165/1	CONDENSER LOOSE ITEMS	2700X1100X800	769
180	78165/2	CONDENSER LOOSE ITEMS	2700X1100X800	769
181	78166/0	CONDENSER STAND PIPE NO.1 LOOSE ITEMS (FOR BOTH COND)	4500X2000X1500	918
182	78167/1	STAND PIPE NO.1(CONDENSER 1&2)	2500X600X500	458
183	78167/2	STAND PIPE NO.2(CONDENSER 1&2)	4200X600X600	458
184	78169/0	CONDENSER STAND PIPES NO.2 LOOSE ITEMS FOR(FOR BOTH COND)	3200X400X400	250
185	78301/0	GLAND STEAM CONDENSER	1750X1700X1700	1510
186	78304/0	LOOSE ITEMS OF GSC	700X300X200	34
187	78305/0	LOOSE ITEMS OF GSC (FRAGILE)	600X500X350	10
188	78315/1	LP HEATER NO.1	12300X2200X2250	27428
189	78315/2	LP HEATER NO.2	12300X2200X2250	27428
190	78316/1	LP HEATER-1 STAND PIPE	1850X550X600	100
191	78316/2	LP HEATER-2 STAND PIPE	1850X550X600	100
192	78317/1	LP HEATER-1 LOOSE ITEMS	500X400X400	64
193	78317/2	LP HEATER-2 LOOSE ITEMS	500X400X400	64
194	78320/1	TROLLEY FOR LP HEATER-1	1350X800X200	332
195	78320/2	TROLLEY FOR LP HEATER-2	1350X800X200	332
196	78401/0	TURBINE OIL COOLER	5800X1700X1700	11000
197	78402/0	TUBINE OIL COOLER	5800X1700X1700	11000
198	78406/0	LOOSE ITEM(TURBINE OIL COOLER)	800X800X500	130
199	78424/0	HYDROGEN COOLER	4800X1200X1300	3000
200	78425/0	HYDROGEN COOLER	4800X1200X1300	3000
201	78428/0	LOOSE ITEMS (HYDROGEN COOLER)	1200X1200X650	650
202	78431/0	EXCITER AIR COOLER	3780X920X830	1072
203	78432/0	EXCITER AIR COOLER	3780X920X830	1072
Total Weight				**8888220**

A.4) Weight Schedule for HEAT EXCHANGERS, Pumps and Motors (BFP,CEP,Drip etc.)

A.4.a) Heater, Deaerator & FST-HYD

ANNEXURE- A.4

Sl.No	Equipment	Quantity	Overall dimensions (in mm)	Dry weight (in kgs)
1	Drain cooler	1	L 6500 x B 1200 x H 2000	6000
2	LP Heater – 3	1	L 12300 x B 1900 x H 2500	25000
3	LP Heater – 4	1	L 14500 x B 2200 x H 2600	30000
4	LP Heater – 5	1	L 12500 x B 2000 x H 2900	25000
5	Deaerator	1	See Below	
6	HP Heater – 7A	1	L 10000 x B 2500 x H 3500	60000
7	HP Heater – 7B	1	L 10000 x B 2500 x H 3500	60000
8	HP Heater – 8A	1	L 12500 x B 2500 x H 3500	83500
9	HP Heater – 8B	1	L 12500 x B 2500 x H 3500	83500
10	HP Heater – 9A	1	L 10000 x B 2400 x H 3500	70500
11	HP Heater – 9B	1	L 10000 x B 2400 x H 3500	70500
12	BFP DT Oil Cooler	2	L 4000 x B 800 x H 2000	4000
13	Deaerator FST-1	1	L 17000 x B 4500x H 4500	220800
14	Deaerator FST-2	1	L 12500 x B 4500 x H 4500	
15	Deaerator FST-3	1	L 17000 x B 4500x H 4500	
16	Deaerator	1	L12000XB3600XH3800	
Total Weight				**738800**

DEAERATOR:

1. Total weight of total Deaerator excluding platform: 220800 kgs.
2. Complete Deaerator along with the FST will be dispatched in 4 sections
3. Weight of heaviest single piece to be handled during erection : 60000kgs

A.4.b) Weight Schedule for BFP-TD-HYD

ANNEXURE- A.5

SL. No.	DESCRIPTION	QTY./UNIT	PACKING SIZE (mm)	APPROX. WT. (KGS)/ Equip.	APPROX. WT. (KGS)/ Both Equip.
		TD BFP- 2 NOs	(L x W x H)		
1	Turbine Driven Boiler Feed Pump (TD BFP) with Base Plate & Tubing	2	3500 x 3100 x 3000	26000	52000
2	Turbine Driven Boiler Feed Booster Pump (TD BP) with Base Plate & Tubing	2	3000 x 2800 x 2000	6500	13000
3	Recirculation Valve	2	1100 x 1100 x 2900	1200	2400
4	Conical Suction Strainer at BFP suction	2	4000 x 1200 x 1200	1400	2800
5	Basket type Suction Strainer at BP suction	2	1500 x 1500 x 2000	2500	5000
Total Weight					**75200**

A.4.c) Weight Schedule for MBDFP – Pump-HYD

ANNEXURE- A.6

SL. No.	DESCRIPTION	QTY./UNIT	PACKING SIZE (mm)	APPROX. WT. (KGS)
		MD BFP- 1 NOs	(L x W x H)	
1	Motor Driven Boiler Feed Pump (MD BFP) with Base Plate & Tubing	1	3500 x 3100 x 3000	20500
2	Motor Driven Boiler Feed Booster Pump (MD BP) with Base Plate & Tubing	1	3000 x 2800 x 2000	4700
3	Hydraulic Coupling	1	4000 x 3000 x 4000	12500
4	HC Working Oil Coolers & accessories	1 Sets	5000 x 1000 x 1000	4500
5	HC Lube Oil Coolers & accessories	1 Sets	2500 x 600 x 600	2500
6	Recirculation Valve	1	1000 x 1000 x 2800	1200
7	Conical Suction Strainer at BFP suction	1	3100 x 1000 x 1000	1600
8	Basket type Suction Strainer at BP suction	1	1500 x 1500 x 1600	2350
9	Connecting Coupling	1	1000x600x500	300
10	MD BFP Motor	1	4700 x 4500 x 3000	43000
Total Weight				**93150**

A.4.d) Weight Schedule for CONDENSATE EXTRACTION Pump-HYD

ANNEXURE- A.7

SL. No.	DESCRIPTION	QTY./UNIT	PACKING SIZE (mm) (L x W x H)	APPROX. WT. (KGS) /Equip.	TOTAL APPROX. WT. (KGS)
1	Condensate Extraction Pump	3	11000 x 3000 x 3000	15000	45000
2	Thrust Bearing Pedestal	3	2000 x 2000 x 1100	2000	6000
3	Sole plate	3	2200 x 2200 x 400	1000	3000
4	Canister	3	7600 x 2200 x 2200	3400	10200
5	Basket type Suction Strainer at CEP suction	3	1750 x 1750 x 2000	1500	4500
6	Connecting Coupling	3	1000 x 600 x 500	300	900
7	CEP Motor	3	3500 (H) X Dia 2100	9500	28500
Total Weight					**98100**

A.4.e) Weight Schedule for DRIP Pump-HYD

ANNEXURE- A.8

SL. No.	DESCRIPTION	QTY./UNIT	PACKING SIZE (mm) (L x W x H)	APPROX. WT. (KGS) (per Equipment)	Total APPROX. WT. (KGS)
1	Drip Pump	2	8500 x 3000 x 1600	5000	10000
2	Sole plate	2	2200 x 2200 x 400	600	1200
3	Canister	2	7600 x 2200 x 2200	3400	6800
4	Basket type Suction Strainer at Drip pump suction	2	1750 x 1750 x 2750	2000	4000
6	Connecting coupling	2	1000 x 500 x 500	300	600
7	Drip pump Motor	2	2500 x 1900 x 3800	3000	6000
Total Weight					**28600**

A.4.f) Weight Schedule for TBDFP – Turbine-HYD

ANNEXURE- A.9

Sl.NO	Equipment Name	Qty	Dimensions in mm (LXWXH)	Weight(Kgs)
1	Steam Turbine	1	4350x4900x4250 (with Gov Valves) 4350x4900x3500 (without Gov Valves)	68000
2	Gear Box	1	1050x1250x1150	1100
3	Lube oil console Package –I (Lube Oil reservoir and Duplex filter with Piping)	1	5100X3100X2750	8600
4	Lube oil console Package –II (Pump assembly with Piping)	1	3000X2800X2950	6900
5	Lube oil console Package-III (Lube oil Coolers with Vent & Drain Piping)	1	3550X435X2700	5700
6	Emergency oil pump assembly	1	2000x1000x2000	1500
7	Jacking oil pump assembly	1	2000X800X600	200
8	Oil purification unit	1	1900x1800x1900	1200
9	Transfer Oil Pump Assembly	1	550X300X320	100
10	Oil accumulators	1	800x800x2200	350
11	Gov oil accumulator	1	800x800x2200	350
12	Governing console	1	1600x1600x2000	680
13	Transition piece	1	3235x 2035X 2185	7250
14	Turbine enclosure	1	5000X6600X4100	7000
15	ESV Assembly (Right & Left)	2	1500X1000X1000	1650
16	Servomotor Assembly	1	1500X1500X2000	350
17	DCSC for Emergency lube oil pump	1	1500X550X1650	400
Total Weight				**111330**

Note: above weight is for one no TDBFP-A

Both TDBFP Weight=111.33x2=222.66 MT

A.5) BOI Items (including turbine integral piping /valves, ME Bellows, PHE, RE Joints, flash tanks, butterfly valves, dosing skids, structural materials etc.)

A.5.a) Weight Schedule for FLASH TANKS-BPL

ANNEXURE- A.10

Sl no	Item Description	Approx. Dimension - L(mm)xB(mm)xH(mm)	Quantity (Nos)	Approx. Total Weight in MT
1	Flash Tank A	4500 x 2600 x 2600	1	4.08
2	Flash Tank B	4500 x 2600 x 2600	1	3.6
3	Unit Flash Tank	2500 x 1500 x 1500	1	1.2
Total Weight				**8.88**

A.5.b) Weight Schedule for MISC. TANKS-BPL

ANNEXURE- A.11

Sl no	Item Description	Approx. Dimension - L(mm)xB(mm)xH(mm)	Quantity (Nos)	Approx. Total Weight in MT(each)
1	DMCW O/H Tank	2500 x 2500 x 7150	1	6
2	Potable Water Tank	4000x4000x2500	1	6.5
Total Weight				**12.5**

A.5.c) Weight Schedule for BOIs-HWR

ANNEXURE- A.12

S NO	ITEM DESC	Gross Wt (Kgs)
1.	BUTTERFLY VALVES	2000
2.	NRV WITH ALUMINIUM FLAP	5000
3.	OIL PURIFICATION UNIT	3000
4.	SPRAY NOZZLES	100
5.	DIRT CATCHERS	100
6.	DAMPER	500
7.	VARIABLE LOAD SPRING CAGES	4000
8.	THERMAL INSULATION OF TURBINE	3630
9.	THERMAL INSULATION OF TIP	7000

10.	TURBINE OIL	62050
11.	TURBINE INTEGRAL PIPING	58000
12.	H & S FOR TURBINE INTEGRAL PIP	35000
13.	CALIBRATED FLOW NOZZLE ASSLY.	1700
14.	CONTROL FLUID (FRF)	3000
15.	LP BYPASS STOP & CONTROL VALVE	19302
16.	STEAM TRAP	35
17.	GEAR PUMP (LUB. OIL RECIRCULATTION)	100
18.	LEVEL INDICATORS FOR OIL TANKS	50
19.	VACUUM BREAKER VALVE WITH PNEUMATIC ACT.	500
20.	HPT STEAM EVACUATION VALVE	670
21.	OIL MODULE	34260
22.	OIL THROTTLE VALVES	200
23.	SEAL STEAM CONTROL VALVE WITH PNEUMATIC ACT.	2000
24.	LEAK STEAM CONTROL VALVE WITH PNEUMATIC ACT.	2000
25.	TURBINE INSTRUMENT RACKS	1000
26.	PNEUMATIC GLOBE VALVE	1000
27.	HYDRAULIC POWER SUPPLY UNIT FOR EHA	4000
28.	ELECTRO-HYDRAULIC ACTUATORS FOR TURBINE VALVES	5000
29.	EMPTY H2 CYLINDER	2550
30.	EMPTY CO2 CYLINDER	1125
31.	EMPTY N2 CYLINDER	180
32.	VAPOUR EXHAUSTER	180
33.	REFRIGERATION GAS DRYER	6000
34.	STROBOSCOPE	120
35.	EXCITER COVER COMPLETE WITH FAN	3000
36.	WELDED AUSTENITIC S.S. TUBES G	395000
37.	CONDENSOR AIR EVACUATION PACKAGE	32000
38.	AIR EXHAUSTER WITH MOTOR	1000
39.	PTFE BEARING SUPPORT	2000
40.	MOISTURE MEASURING SYSTEM	2000
41.	MOTORISED TEMPERATURE CONTROL VALVE FOR COLD GAS	1000

42.	PW TEMPERATURE CONTROL VALVE	1000
43.	CONSTANT LOAD SPRING CAGES	2000
44.	DOUBLE THREE WAY VALVES	3000
45.	PRIMARY WATER PUMP & MOTOR SET	2000
Total Weight		**709352**

A.5.d) Weight Schedule for RE Joints- Bhopal

ANNEXURE- A.13

Sl no	Item Description	Approx. Dimension (mm)	Quantity (Nos)	Approx. Total Weight (in MT)
1	2300 NB COMPENSATING TYPE RE JOINTS	Dia 3300 X Length 1200	14	110.00

A.5.e) Weight Schedule for BFV-Bhopal

ANNEXURE- A.14

Sl no	Item Description	Approx. Dimension - L(mm)xB(mm)xH(mm)	Quantity (Nos)	Approx. Total Weight in MT
1	2300 - E	3800 X 3200 X 800	4	45.44
2	900 - M#	1800 X 1200 X 500	1	1.809
3	900 - M	1800 X 1200 X 500	5	9.02
4	700 - E	1600 X 1100 X 400	3	3.78
5	600 - E	1500 X 900 X 600	3	2.229
6	600 - M	1500 X 1100 X 400	1	0.713
7	500 - M	1300 X 800 X 350	2	1.116
8	450 - E	1300 X 800 X 350	3	1.281
9	450 - M	1300 X 800 X 350	6	2.322
10	400 - E	1100 X 600 X 300	4	1.488
11	400 - M	1100 X 600 X 300	9	3.213
Total Weight				**72.411**

A.5.f) BOIs- PEM

A.5.f .i) Weight Schedule for pumps Horizontal and ME Bellows

ANNEXURE- A.15

Sl no	Item Description	Approx. Dimension L(mm)xB(mm)xH(mm)	Quantity	Approx. Total Weight in MT
1	ACW PUMPS (HORIZONTAL)	3500MM X 1500MM (BASE PLATE DIM.)	3	18
2	DMCW-TG PUMPS (HORIZONTAL)	3500MM X 1500MM (BASE PLATE DIM.)	3	18
3	CONDENSATE TRANSFER PUMPS (HORIZONTAL)	2500MM X 1000MM (BASE PLATE DIM.)	1	4
				40
4	ME BELLOWS			35
			Total Weight	**75**

A.5.f.ii) Weight Schedule for BOI-PEM Others

ANNEXURE- A.16

Sl no	Item Description	Approx. Dimension L(mm)xB(mm)xH(mm)	Quantity	Approx. Total Weight in MT
1	COLTCS	3000MM x 5000MM	2	32
2	SCS	2000MM X 1500MM	2	10
3	PHEs-TG	5000MM x 2500MM	3	36
4	CONICAL STRAINERS (500NB)	L= 700MM; DIA=500NB	3	1.75
5	CONICAL STRAINERS (250NB)	L= 400MM; DIA=250NB	1	0.1
Total Weight				**79.85**

A.5.f.iii) Weight Schedule for PEM – CHAIN PULLEY BLOCKS

ANNEXURE- A.17

SR. NO	PACKAGE DESCRIPTION	QUANTITY FOR STATION (Nos)	WEIGHT	
			PER UNIT (In Tonnes)	TOTAL FOR STATION (In Tonnes)
1	CHAIN PULLEY BLOCK (CPB)	5	0.1	0.5

A.5.f.iv) Weight Schedule for PEM – ELECTRIC HOISTS

ANNEXURE- A.18

SR. NO	PACKAGE DESCRIPTION	QUANTITY FOR STATION (Nos)	WEIGHT	
			PER UNIT (In Tonnes)	TOTAL FOR STATION (In Tonnes)
1	ELECTRIC HOISTS	7	1	7

A.5.f.v) Weight Schedule for Lube Oil Transfer Pumps

ANNEXURE- A.19

Sl no	Item Description	Approx. Dimension L(mm)xB(mm)xH(mm)	Quantity	Approx. Total Weight in Kg.
1.	Lube Oil transfer pump + motor set+ Duplex strainer	1.5 M X 0.6 M X 0.5M	1	600
Total Weight				**600**

A.5.f.v) Weight Schedule for Dozing System

CHEMICAL DOSING SYSTEM

ANNEXURE- A.20

S. No.	System	No. of skids (Each Unit)	Approx. weight (Empty) each (Kg)	Approx. weight (Filled)each (Kg)
1.	NaOH Dosing System	1	1000	1000

A.6) Weight Schedule for 3x1500 KVA Emergency DG Sets

ANNEXURE- A.21

S NO.	*ITEMS*	*QUANTITY*	*WEIGHT OF EACH SET*	*TOTAL WEIGHT*
1	1. 1500 KVA DG SET 2. ACOUSTIC ENCLOSURE 3.990 LTRS FUEL TANK AND PIPING 4.SILENCERS AND EXHAUST PIPES AND ACCESSORIES 5. EXHAUST SUPPORT STRUCTURE 6.CABLES AND ACCESSORIES 7.AMF / CONTROL PANELS, DBs, BATTERY CHARGER, BATTERY 8.CONSUMMABLES - LUBE OIL, COOLANT AND FILTERS 9.MANDATORY SPARES , TOOLS AND TACKLES	3 SET	35 TONS (APPROX)	105 TONS

B) Piping and Insulation Scope (Item Rate-Rate per MT)

B.1) PEM Supply Valves, Traps, & Thermal Insulation Material

ANNEXURE- A.23

SL. NO.	PACKAGE DESCRIPTION	WEIGHT For a Unit (In Tonnes)
1	LRB MATTRESS	208
2	ANC MATERIAL	12
3	AL. SHEET	35
4	BALL VALVES	3
5	AIR TRAPS	0.25
6	STEAM TRAPS	0.25
7	AIR RELEASE VALVES	0.75
8	BUTTERFLY VALVE-STEAM SERVICE	14.5
Total Weight		**273.75**

B.2) Weight Schedule for CW, LP & HP Piping

ANNEXURE- A.24

S.no	Description(CW & LP Piping)	Weight in MT
1	Stainless Steel Pipes	1
2	stainless Fittings	0.25
3	Carbon Steel Pipes	321.35
4	Carbon steel piping -large dia	132.5
5	Carbon steel fittings	41
6	H&S	14
7	Aux. Structures	14
8	LP Valves & Accessories	15
9	Temporary Piping	30
	Total	**569.1**

S.no	Description(HP Piping)	Weight in MT
1	Stainless steel Pipes	1.5
2	Stainless steel Fittings	0.25
3	Alloy Steel Pipes	15
4	Alloy Steel Fittings	3.5
5	Carbon Steel Pipes	621.8
6	Carbon Steel Fittings	204.4
7	H&S	87.5
8	Aux. Structures	83
9	Plates, BOI, Sub-Deliveries	8
10	HP Valves & Accessories	210
	Total	**1234.95**

PGMA wise Weight schedule of LP and HP Piping:

PG	MA	WBS Description	Unit	Estimated Wt
80	307	HP AND LP BYPASS WARM UP	KG	500
80	312	LPBP VALVE UPSTREAM AND DOWNSTREAM	KG	10,000.00

80	322	CRH PIPING TO DEAERATING HEATER	KG	9,800.00
80	323	STEAM TO BFP DRIVE TURBINE	KG	8,600.00
80	329	EXTRACTION STEAM TO BFP DRIVE TURBINE	KG	12,000.00
80	332	EXTRACTION STEAM TO LP HEATER-3	KG	20,000.00
80	334	EXTRACTION STEAM TO LP HEATER-5	KG	12,000.00
80	335	EXTRACTION STEAM TO DEAERATING HEATER	KG	17,000.00
80	336	EXTRACTION STEAM TO HP HEATER NO.1	KG	17,000.00
80	337	EXTRACTION STEAM TO HP HEATER-2	KG	8,000.00
80	338	EXTRACTION STEAM TO HP HEATER-3	KG	8,000.00
80	339	AUX STEAM TO BFD TURBINE	KG	3,000.00
80	345	AUX STEAM TO DEAERATING HEATER	KG	4,000.00
80	349	AUX STEAM TO GLAND SEALS - TG SCOPE	KG	800
80	363	EXHAUST STEAM FROM PRIME MOVERS-TG SCOPE	KG	33,000.00
80	371	DRAIN FLASH TANK VENT TO CONDENSER	KG	2,900.00
80	375	UNLISTED SV EXHAUSTS - TG SCOPE	KG	4,000.00
80	379	HPH SV EXHAUST TO FLASH TANK	KG	12,000.00
80	381	HP HEATER VENTS - TG SCOPE	KG	4,000.00
80	382	LP HEATER VENTS	KG	2,600.00
80	385	VENT FROM UNLISTED PPG/EQPT TO COND	KG	3,600.00
80	388	CONDENSER AIR EVACUATION PIPING	KG	5,000.00
80	400	CONDENSATE SUCTION	KG	10,000.00
80	401	CD FROM PUMP TO LPH1/DC INLET TEE AND RE	KG	56,000.00
80	402	CD FROM LPH1/DC INLET TEE TO TG TP	KG	15,000.00
80	403	CD FROM TG TP TO DEAERATING HEATER	KG	15,000.00
80	407	CONDENSATE FOR SEALING OF VACUUM	KG	4,000.00
80	408	CONDENSATE DUMP FROM HEADER	KG	1,500.00
80	412	CONDENSATE TRANSFER	KG	2,500.00
80	419	DEAERATOR SAFETY VALVE EXHAUST TO ATM	KG	5,000.00
80	420	BOILER FEED PUMP SUCTION	KG	22,000.00
80	421	BOILER FEED PUMP RECIRCULATION	KG	16,000.00
80	423	BOILER FEED PUMP TO HPH INCLUDING BYPASS	KG	1,75,000.00
80	424	BFD BETWEEN HTRS AND GROUP PROTECTION	KG	35,000.00
80	425	BFD FROM FINAL HPH TO SG TP	KG	1,05,000.00
80	430	SPRAY WATER TO HPBP	KG	5,000.00
80	433	SPRAY WATER FROM BFP INTERSTAGE	KG	21,000.00
80	436	SPRAY WATER TO LPBP DESH	KG	4,000.00
80	442	GLAND STEAM COOLER DRAINS	KG	500
80	444	LP HEATER-2/3/4/5 DRAINS AND DRIP PUMP I	KG	15,000.00
80	446	DEAERATING HEATER OVER FLOW AND DRAIN	KG	3,400.00

80	447	HP HEATER DRAINS	KG	33,000.00
80	448	DRAIN FROM UNLISTED EQPT/VESSEL-TG SCOPE	KG	2,800.00
80	449	TG CYCLE PIPING DRAINS AND VENTS	KG	23,000.00
80	452	HP PIPING DRAINS - SG SCOPE	KG	5,000.00
80	453	LP PIPING DRAINS - SG SCOPE	KG	5,000.00
80	457	MANIFOLDS FOR HP FLASH BOX AND CONDENS	KG	900
80	459	HP FLASH TANK DRAIN TO CONDENSER	KG	800
80	463	TG AUX COOLING WATER	KG	2,17,000.00
80	468	MAIN CIRCULATION WATER PIPING	KG	1,20,000.00
80	473	DEMINERALISED WATER SYSTEM	KG	9,700.00
80	477	SERVICE WATER PIPING	KG	14,700.00
80	478	DRINKING WATER PIPING	KG	9,000.00
80	493	HP FLASH TANK VENT TO CONDENSER	KG	1,700.00
80	494	LP FLASH TANK VENT TO CONDENSER	KG	1,900.00
80	495	LP FLASH TANK DRAIN TO COND	KG	2,300.00
80	601	LOW PRESSURE DOSING PIPING	KG	3,500.00
80	604	ACID CLEANING PIPING-TEMPORARY	KG	98,000.00
80	610	SERVICE AIR-COMP SUCT AND DIS TO RECEI	KG	15,000.00
80	614	INST AIR COMP SUC AND DIS TO RECEIVER	KG	17,500.00
80	673	LUBE OIL PIPING SYSTEM	KG	12,000.00
80	901	SUB DELIVERY VALVES FOR LIGHT UP	KG	500
80	928	H AND S FOR BOILER LIGHT UP - TG	KG	75,000.00
80	930	H AND S FOR SYNCHRONISATION - TG	KG	76,000.00
80	933	H AND S FOR LP PIPING	KG	41,000.00
80	941	VLH AND CLH for BFD PPG -HERP	KG	13,000.00
80	942	VLH AND CLH for TG PPG -HERP	KG	13,000.00
80	992	WELDING FILLERS/ELECTRODE-1	KG	500
80	993	MISC ERECTION MATLS	KG	3,100.00
		HP Valves & Accessories	KG	233050.00
		LP Valves & Accessories	KG	15000
Total Weight			KG	1804000

MOTORISED Valves and ACTUATOR DETAILS

(Tentative details of the valves of approx 210 MT HP and LP valves (Motorised and Pnematic) are as detailed below, These may increase/change on finalisation of engineering/ release of drawings for erection at site.)

Tag Number	Material Description	Net Weight(KG)
ASV104	1-C800-SV-SW-MO-A105	86

CRHV116	1-C800-SV-SW-MO-A105	86
CRHV135	1-C800-SV-SW-MO-A105	86
CRHV147	1-C800-SV-SW-MO-A105	86
CRHV153	1-C800-SV-SW-MO-A105	86
EXV109	1-C800-SV-SW-MO-A105	86
EXV115	1-C800-SV-SW-MO-A105	86
SMV33	1-C800-SV-SW-MO-A105	86
SMV13	1-C800-SV-SW-MO-A105	86
SMV10	1-C800-SV-SW-MO-A105	86
SMV4	1-C800-SV-SW-MO-A105	86
SMV17	1-C800-SV-SW-MO-A105	86
SMV19	1-C800-SV-SW-MO-A105	86
SMV27	1-C800-SV-SW-MO-A105	86
CHDV11	1-C800-SV-SW-MO-F316-SST	87
CHDV13	1-C800-SV-SW-MO-F316-SST	87
CHDV15	1-C800-SV-SW-MO-F316-SST	87
CHDV17	1-C800-SV-SW-MO-F316-SST	87
CHDV7	1-C800-SV-SW-MO-F316-SST	87
CHDV9	1-C800-SV-SW-MO-F316-SST	87
CHDV1	1-C800-SV-SW-MO-F316-SST	87
CHDV3	1-C800-SV-SW-MO-F316-SST	87
ASV153	1-1/2-C800-SV-SW-MO-A105	86
ASV178	2-C800-SV-SW-MO-A105	87
CDV261	2-C800-SV-SW-MO-A105	87
CDV264	2-C800-SV-SW-MO-A105	87
CRHV101	2-C800-SV-SW-MO-A105	87
EXV29	2-C800-SV-SW-MO-A105	87
EXV30	2-C800-SV-SW-MO-A105	87
SMV22	2-C800-SV-SW-MO-A105	87

ASV164	2-C3750SPL-SV-SW-MO-F91	143
EXV25A	2-C800-GV-SW-MO-A105	82
EXV26A	2-C800-GV-SW-MO-A105	82
EXV155	2-C800-GV-SW-MO-A105	82
DMV35	2-C800-GV-SW-MO-F316	82
DMV47	2-C800-GV-SW-MO-F316	82
EXV105	2-C1500-SV-SW-MO-F22	128
EXV165	2-C1500-SV-SW-MO-F22	128
FDV55	1-1/2-C3000SPL-SV-SW-MO-A105	126
FDV59	1-1/2-C3000SPL-SV-SW-MO-A105	126
FDV63	1-1/2-C3000SPL-SV-SW-MO-A105	126
DMV36	3-C150-GV-BW-MO-CF8	91
DMV17	3-C150-GV-BW-MO-CF8	91
DMV1	4-C150-GV-BW-MO-CF8	114
DMV2	4-C150-GV-BW-MO-CF8	114
ASV13	3-C300-GV-BW-MO-WCB	105
DMV45	4-C300-RV-BW-MO-CF8-SG	207
DMV30	6-C300-SV-BW-MO-CF8	253
DMV32	6-C300-SV-BW-MO-CF8	253
DMV42	6-C150-GV-BW-MO-CF8	129
DRV13	4-C300-GV-BW-MO-WC9-SG	120
EXV35	22-C300-GV-BW-MO-WCB	1700
EXV12	26-C300-GV-BW-MO-WCB	2780
EXV11	32-C150-GV-BW-MO-WCB-SG	3384
DMV10	3-C300-SV-BW-MO-CF8	125
DMV12	3-C300-SV-BW-MO-CF8	125
CDV7	3-C300-GV-BW-MO-WCB	105
CDV8	3-C300-GV-BW-MO-WCB	105
CDV9	3-C300-GV-BW-MO-WCB	105

SMV41	4-C300-GV-BW-MO-WCB-SG	130
DMV22	6-C300-SV-BW-MO-CF8	253
DMV24	6-C300-SV-BW-MO-CF8	253
CDV92	6-C300-GV-BW-MO-WCB	195
DRV87	6-C300-GV-BW-MO-WCB	195
ASV6	6-C300-RV-BW-MO-WCB	250
CDV41	6-C300-RV-BW-MO-WCB	250
CDV38	8-C300-GV-BW-MO-WCB	295
CDV42	8-C300-GV-BW-MO-WCB	295
DRV88	8-C300-GV-BW-MO-WCB	295
ASV1	8-C300-GV-BW-MO-WCB	295
ASV7	8-C300-GV-BW-MO-WCB	295
ASV10	8-C300-RV-BW-MO-WCB	430
CDV4	12-C300-GV-BW-MO-WCB	534
CDV5	12-C300-GV-BW-MO-WCB	534
CDV6	12-C300-GV-BW-MO-WCB	534
EXV22	14-C300-GV-BW-MO-WC9	698
EXV13	16-C300-GV-BW-MO-WCB	960
CDV27	16-C400-RV-BW-MO-WCB	2013
CDV10	18-C300-GV-BW-MO-WCB	992
CDV21	18-C300-GV-BW-MO-WCB	992
CDV24	18-C300-GV-BW-MO-WCB	992
CDV28	18-C300-GV-BW-MO-WCB-BP	1093
DRV79	6-C300SPL-RV-BW-MO-WCB	254
CDV30	16-C300SPL-GV-BW-MO-WCB	941
CDV12	16-C400-RV-BW-MO-WCB	2013
CDV33	16-C400-RV-BW-MO-WCB	2644
CDV36	16-C400-RV-BW-MO-WCB	2013
CDV91	16-C400-RV-BW-MO-WCB	2013

CDV11	18-C300SPL-GV-BW-MO-WCB-BP	1057
CDV29	18-C300SPL-GV-BW-MO-WCB-BP	1057
CDV31	18-C300SPL-GV-BW-MO-WCB	992
CDV32	18-C300SPL-GV-BW-MO-WCB-BP	1057
CDV34	18-C300SPL-GV-BW-MO-WCB	992
CDV35	18-C300SPL-GV-BW-MO-WCB-BP	1057
CDV89	18-C300SPL-GV-BW-MO-WCB	992
CDV90	18-C300SPL-GV-BW-MO-WCB-BP	1057
ASV25	4-C1500-GV-BW-MO-WCC	185
ASV28	4-C1500-GV-BW-MO-WCC	185
ASV29	4-C1500-GNV-BW-MO-WCC	229
CRHV1	8-C600-GV-BW-MO-WCC	400
EXV34	10-C1500-GV-BW-MO-WC9-PR	937
CRHV5	14-C1500-GV-BW-MO-WCC -BP- PR	2275
EXV24	14-C1500-GV-BW-MO-WCC-PR	1630
FDV13	14-C3000SPL-GV-BW-MO-WCC-BP - PR	3747
FDV15	14-C3000SPL-GV-BW-MO-WCC-BP - PR	3747
FDV28	14-C2500SPL-GV-BW-MO-WCC-BP-PR	3250
FDV29	14-C3000SPL-GV-BW-MO-WCC-BP - PR	3747
FDV33	14-C2500SPL-GV-BW-MO-WCC-PR	3250
FDV4	16-C3000SPL-GV-BW-MO-WCC-BP-PR	4884
FDV5	16-C3000SPL-GV-BW-MO-WCC-BP-PR	4884
FDV6	16-C3000SPL-GV-BW-MO-WCC-BP-PR	4884
FDV23	22-C2750SPL-GV-BW-MO-WCC-PR	8293
FDV24	22-C2750SPL-GV-BW-MO-WCC-BP-PR	8144
FDV30	22-C2750SPL-GV-BW-MO-WCC-PR	8293
FDV31	22-C2750SPL-GV-BW-MO-WCC-PR	8293
FDV7	22-C2750SPL-GV-BW-MO-WCC-BP-PR	8144
FDV16	22-C3000SPL-GV-BW-MO-WCC-BP-PR-TEMP.300C	8850

FDV25	22-C2750SPL-GV-BW-MO-WCC-PR	8293
FDV26	22-C2750SPL-GV-BW-MO-WCC-BP-PR	8144
FDV27	22-C2750SPL-GV-BW-MO-WCC-PR	8293
FDV32	22-C2750SPL-GV-BW-MO-WCC-PR	8293
ASV21	8-C3750SPL-GV-BW-MO-C12A-BP-PR	1174
XAL01AA254	1-C800-SV-SW-MO-A105	86
XAL01AA255	1-C800-SV-SW-MO-A105	86
XAL01AA256	1-C800-SV-SW-MO-A105	86
XAL01AA257	1-C800-SV-SW-MO-A105	86
XAL02AA254	1-C800-SV-SW-MO-A105	86
XAL02AA255	1-C800-SV-SW-MO-A105	86
XAL02AA256	1-C800-SV-SW-MO-A105	86
XAL02AA257	1-C800-SV-SW-MO-A105	86
MAW60AA251	1-C800-SV-SW-MO-A105	86
MAW61AA251	1-C800-SV-SW-MO-A105	86
MAW70AA252	1-1/2-C800-RV-SW-MO-A105	84
MAW71AA252	1-1/2-C800-RV-SW-MO-A105	84
MAW70AA106	1-1/2-C800-GV-SW-MO-A105	81
MAW71AA106	1-1/2-C800-GV-SW-MO-A105	81
XAL01AA258	2-C800-SV-SW-MO-A105	87
XAL02AA258	2-C800-SV-SW-MO-A105	87
MAW70AA253	4-C300-RV-BW-MO-WCB-SG	155
XAV50AA201	3-C300-RV-FL-MO-WCB	113
XAV51AA201	3-C300-RV-FL-MO-WCB	113
DMCW67	10-C150-GV-BW-MO-WCB	236
DMCW81	2-C800-SV-SW-MO-F316-SST	110
DMCW83	2-C800-SV-SW-MO-F316-SST	110
DMCW37	10-C300-SV-BW-MO-WCB	300
MAW10AA011	3-C300-GV-BW-MO-WCB	85

MAW10AA101	3-C300-RV-BW-MO-WCB	108
MAN90AA001	8-C300-RV-BW-MO-WCB	430
MAN90AA002	8-C300-RV-BW-MO-WCB	430
MAW50AA011	18-C300-GV-BW-MO-C12A	1028
MAW50AA101	18-C300-RV-BW-MO-C12A	2212
MAW71AA253	4-C300-RV-BW-MO-WCB-SG	155
FDV55	1-1/2-C3000SPL-SV-SW-MO-A105	74
FDV59	1-1/2-C3000SPL-SV-SW-MO-A105	74
FDV63	1-1/2-C3000SPL-SV-SW-MO-A105	74
PW51	3-C150-GV-BW-MO-WCB	130
PW52	3-C150-GV-BW-MO-WCB	130
EXV165	2-C800-GV-SW-MO-F316	72.500
EXV105	2-C800-GV-SW-MO-F316	72.500
ASV21	3-C3750SPL-GV-BW-MO-C12A	280
DMV35	3-C3750SPL-GV-BW-MO-C12A	280
DMV47	8-C3750SPL-GV-BW-MO-C12A-BP-PR	1174

Valve details with pneumatic Actuator		
Tag Number	Material Description	Net Weight(Kg)
EXV1	QCNRV-32"-C150-WC6-WA-LHS-CWT-NTPC	4400
EXV3	QCNRV-24"-C150-WC6-WA--RHS-CNTWT	2400
EXV4	QCNRV-20"-C150-WC6-WA--LHS-NTPC	1460
EXV6	QCNRV-24"-C150-WC6-WA--RHS-WO-CNTWT(SPL)	2500
EXV9	QCNRV-14"-C600-WC9-WA--RHS-NTPC	1135
EXV31	QCNRV-08"-C900-WC9-WA--LHS(SPL)-NTPC	650
CRHLINE	CRHNRV-34"-C700SPL-WC9-WA-LHS-WLS-NTPC	13300
MAL81AA051	25/40-C1500-PNU(3S)-SW-MO-F91	224
MAL14AA051	40/50-C1500-PNU(3S)-BW-MO-F22	283
MAL25AA051	40/50-C1500-PNU(3S)-BW-MO-F22	283

MAL51AA051	50/65-C1500-PNU-BW-MO-A105	279
MAL54AA051	50/65-C1500-PNU-BW-MO-A105	279
MAL55AA051	50/65-C1500-PNU-BW-MO-A105	279
MAL41AA051	50/65-C1500-PNU-BW-MO-F22	279
MAL45AA051	50/65-C1500-PNU-BW-MO-F22	279
MAL47AA051	50/65-C1500-PNU-BW-MO-F22	279
MAL26AA051	50/65-C1500-PNU-BW-MO-F91	279
MAL27AA051	50/65-C1500-PNU-BW-MO-F91	279
MAL23AA051	50/65-C1500-PNU(3S)-BW-MO-F91	279
MAL24AA051	50/65-C1500-PNU(3S)-BW-MO-F91	279
MAL31AA051	50/65-C1500-PNU(3S)-BW-MO-F91	279
MAL20AA051	50/65-C2500-PNU-BW-MO-F91	279
MAL22AA051	50/65-C2500-PNU-BW-MO-F91	279
MAL11AA051	50/65-C3750SPL-PNU-BW-MO-F91	279
MAL12AA051	50/65-C3750SPL-PNU-BW-MO-F91	279
MAL19AA051	50/65-C3750SPL-PNU-BW-MO-F91	279

Piping Material Specifications & size details

Line Description	Pipe Material	Selected Pipe Size (mm x mm)
HP/LP BYPASS SYSTEM		
HP BYPASS NO.1 / 2 WARM UP LINE 10.55 44.45 x 10.67	SA 335 P92	44.45 x 10.67
HP BYPASS SPRAY FROM BFP DISCH	SA 106 Gr C	168.3 x 27.5
SPRAY FROM BFP DISCHARGE (TO BPE-1 / 2UPTO NRV	SA 106 Gr C	114.3 x 20
SPRAY FROM BFP DISCHARGE (TO BPE-1 / 2) AFTER NRV	SA 335 P22	114.3 x 22
LP BYPASS VALVE TO CONDENSER(NORMAL)	SA 691 CL22	1118 x 28
LP BYPASS VALVE TO CONDENSER (CHECK CASE)	SA 691 CL22	1118 x 28
HRH TO LPBP WARM UP LINE	SA 335 P92	38.1 x 7.11

LP BYPASS VALVE BODY DRAIN CONNECTION LINE	SA 335 P92	38.1 x 7.11
SPRAY TO LPBP EH & TUR F/B	SA 106 Gr C	273 x 12.7
HP BYPASS SPRAY LINE RECIRCULATION TO DEAERATOR	SA 106 Gr C	33.4 x 9.09
HP BYPASS SPRAY LINE DRAIN BEFORE NRV	SA 106 Gr C	33.4 x 9.09
HP BYPASS SPRAY LINE DRAIN AFTER NRV	SA 335 P92	44.45 x 10.67
MS, HRH, CRH SYSTEM		
CRH NRV DRAIN TO DRAIN POT DRAIN	SA 335 P22	60.3 x 5.54
EVACUATION LINE FROM CRH TO CONDENSER	SA 335 P22	168.3 x 10.97
CRH TO DEAERATOR, HP HEATERS 8A & B & BFP TURBINES	SA 335 P22	406.4 x 22.2
STUB FOR MS LINE DRAIN TO UNIT FLASH TANK	SA 335 P22	168.3 x 10.97
STUB FOR HRH LINE DRAIN TO FLASH TANK-B	SA 335 P22	88.9 x 7.62
STUB FOR MS LINE DRAIN TO FLASH TANK-B	SA 335 P22	88.9 x 7.62
STUB FOR HRH LINE DRAIN TO UNIT FLASH TANK	SA 335 P22	88.9 x 7.62
MS STOP VALVE SPINDLE LEAK-OFF TO UNIT FLASH TANK	SA 335 P22	60.3 x 5.54
HRH STOP VALVE SPINDLE LEAK-OFF TO UNIT FLASH TANK	SA 335 P22	60.3 x 5.54
EXTRACTION STEAM TO HEATERS		
LPT HALF FLOW TO LPH-3	SA 106 Gr C	660 x 22
LPT FULL FLOW TO LPH-3	SA 672 B70	813 x 10
LPT HALF FLOW TO LPH-4	SA 106 Gr C	406.4 x 9.53
LPT FULL FLOW TO LPH-4	SA 106 Gr B	559 x 9.53
IPT TO LPH-5(U/S OF NRV)	SA 106 Gr C	406.4 x 9.53
IPT TO LPH-5(D/S OF NRV)	SA 106 Gr B	457 x 9.53
EXTRN. TO D/A AND BFP TURBINES (U/S OF NRV)	SA 106 Gr B	559 x 9.53
EXTRN LINE TO BFP TURBINES (COMMON LINE)	SA 106 Gr B	508 x 16
EXTRN STEAM TO DEA	SA 106 Gr C	406.4 x 9.53

EXTRN STEAM FROM NRV TO D/A (D/S OF EXPANDER)	SA 672 B70	965 x 10
EXTRN FROM IPT TO HPH-7A & 7B FULL FLOW	SA 335 P22	323.9 x 11.13
EXTRN FROM IPT TO HPH-7A / 7B HALF FLOW	SA 335 P22	219.1 x 12.7
EXTRN FROM CRH LINE TO HPHs 8A/8B FULL FLOW	SA 106 Gr C	273 x 15.09
EXTRN FROM CRH LINE TO HPH-8A / 8B (HALF FLOW)	SA 106 Gr C	219.1 x 12.5
EXTRN TO HPH-9 HALF FLOW (TURBINE END)	SA 335 P22	168.3 x 10.97
EXTRN TO HPH-9A & 9B FULL FLOW	SA 335 P22	219.1 x 25
EXTRN TO HPH-9A & 9B FULL FLOW BETWEEN NRVs	SA 335 P22	219.1 x 25
EXTRN TO HPH-9A / 9B (HALF FLOW)	SA 335 P22	168.3 x 10.97
CRH TO D/A PEGG (U/S OF CV)	SA 106 Gr C	355.6 x 36
CRH TO D/A PEGG (D/S OF CV UPTO IV)	SA 106 Gr C	965 x 47
CRH TO D/A PEGG (D/S OF CV IV UPTO NRV)	SA 672 B70	965 x 10
CRH TO D/A PEGG (D/S OF CV) LINE DRAIN	SA 106 Gr B	33.4 x 4.55
CRH TO D/A PEGG WARM UP LINE	SA 106 Gr B	33.4 x 4.55
CRH TO D/A PEGG (D/S OF NRV)	SA 672 B70	965 x 10
CRH TO BFPT COMMON LINE	SA 106 Gr C	273 x 15.09
AUX. STEAM FOR DEA PEGGING (U/S OF CV)	SA 106 Gr B	219.1 x 6.35
AUX STEAM FOR D/A PEGGING (D/S OF CV)	SA 106 Gr B	457 x 9.53
AS FOR D/A PEGG (FROM SCNRV D/S OF CV)	SA 106 Gr B	457 x 9.53
AUX. STM TO D/A PEGG U/S OF RGLV	SA 106 Gr B	219.1 x 6.35
AUX. STM TO D/A PEGG D/S OF RGLV	SA 106 Gr B	457 x 9.53
AUX. STM TO D/A INIT HTG	SA 106 Gr B	168.3 x 7.11
AUX. STM TO D/A INIT HTG D/S OF RGLV	SA 106 Gr B	355.6 x 9.53
BFPT A/B EXHAUST TO COND	SA 672 B70	1829 x 16
AUX STM TO DEA PGG DRIP LEG (U/S OF CV)	SA 106 Gr B	114.3 x 6.02
AUX STM TO DEA PGG DRIP LEG (U/S OF CV) DRAIN	SA 106 Gr B	33.4 x 4.55
AUX STM TO DEA PGG DRIP LEG (D/S OF CV)	SA 106 Gr B	219.1 x 6.35
AUX STM TO DEA PGG DRIP LEG (D/S OF CV) DRAIN	SA 106 Gr B	33.4 x 4.55
AUX STM TO DEA PGG DRIP LEG TO FLASH PIPE'A'	SA 106 Gr B	33.4 x 4.55

AS TO D/A PEGG DRIP LEG TO FLASH PIPE'A' BYPASS LINE	SA 106 Gr B	33.4 x 4.55
AUX STM TO DEA PGG DRIP LEG TO FLASH PIPE'A'	SA 106 Gr B	33.4 x 4.55
AS TO D/A PEGG DRIP LEG TO FLASH PIPE'A' BYPASS LINE	SA 106 Gr B	33.4 x 4.55
CRH TO DEA PEGGING LINE DRIP LEG (D/S OF CV)	SA 106 Gr C	323.9 x 9.53
CRH TO DEA PGG LINE DRN POT TO F/T - A	SA 106 Gr B	33.4 x 4.55
CRH TO DEA PGG LINE DRN POT DRAIN	SA 106 Gr B	33.4 x 4.55
LPH3 RELIEF VALVE EXHAUST TO FLASH PIPE'B'	SA 106 Gr B	168.3 x 7.11
LPH4 RELIEF VALVE EXHAUST TO FLASH PIPE'B	SA 106 Gr B	168.3 x 711
LPH5 RELIEF VALVE EXHAUST TO FLASH PIPE'B'	SA 106 Gr B	168.3 x 7.11
HPH-7A RELIEF VALVE EXHAUST TO FLASH PIPE'B'	SA 106 Gr B	168.3 x 7.11
HPH-7B RELIEF VALVE EXHAUST TO FLASH PIPE'B'	SA 106 Gr B	168.3 x 7.11
HPH-8A RELIEF VALVE EXHAUST TO FLASH PIPE'A'	SA 106 Gr B	114.3 x 6.02
HPH-8B RELIEF VALVE EXHAUST TO FLASH PIPE'A'	SA 106 Gr B	114.3 x 6.02
HPH-9A RELIEF VALVE EXHAUST TO FLASH PIPE'A'	SA 106 Gr B	114.3 x 6.02
HPH-9B RELIEF VALVE EXHAUST TOFLASH PIPE'A'	SA 106 Gr B	114.3 x 6.02
FLASH PIPE'A' & ITS VENT	SA 106 Gr B	508 x 16
FLASH PIPE'A' SYPHONIC DRAIN TO WASTE	SA 106 Gr B	273 x 9.27
FLASH PIPE'B' & ITS VENT	SA 106 Gr B	508 x 16
FLASH PIPE'B' SYPHONIC DRAIN TO WASTE	SA 106 Gr B	323.9 x 9.53
EXTN TO HPH-7A&7B DRIP LEG BEFORE NRV	SA 335 P22	168.3 x 7.11
EXTN TO HPH-7A&7B DRIP LEG AFTER NRV	SA 335 P22	168.3 x 7.11
EXTN TO HPH-9A & 9B DRIP LEG BEFORE NRV	SA 335 P22	114.3 x 8.56
EXTN TO HPH-9A / 9B DRIP LEG AFTER NRV	SA 335 P22	114.3 x 8.56
EXTN TO DEA DRIP LEG BEFORE NRV	SA 106 Gr B	219.1 x 6.35
EXTN TO DEA DRIP LEG AFTER NRV	SA 106 Gr B	219.1 x 6.35
EXTN TO DEA DRIP LEGS DRAIN	SA 106 Gr B	33.4 x 4.55

EXTN TO LPH-3 DRIP LEG	SA 106 Gr C	323.9 x 9.53
EXTN TO LPH-3 DRIP LEG DRAIN	SA 106 Gr B	33.4 x 4.55
EXTN TO LPH-3 HALF FLOW LINE DRAIN	SA 106 Gr B	60.3 x 5.54
EXTN TO LPH-4 DRIP LEG	SA 106 Gr B	219.1 x 6.35
EXTN TO LPH-4 DRIP LEG DRAIN	SA 106 Gr B	33.4 x 4.55
EXTN TO LPH-3 HALF FLOW LINE DRAIN	SA 106 Gr B	60.3 x 5.54
EXTN TO LPH-5 DRIP LEG	SA 106 Gr B	219.1 x 6.35
EXTN TO LPH-5 DRIP LEG DRAIN	SA 106 Gr B	33.4 x 4.55
EXTN TO LPH-5 DRIP LEG AFTER NRVs	SA 106 Gr B	219.1 x 6.35
EXTN TO LPH-5 DRIP LEG DRAIN	SA 106 Gr B	33.4 x 4.55
AUX STM TO DEA PGG LINE DRAIN/VENTS (U/S OF CV)	SA 106 Gr B	33.4 x 4.55
AUX STM TO DEA PGG LINE DRAIN/VENTS (D/S OF CV)	SA 106 Gr B	33.4 x 4.55
HEATER DRAINS & VENTS		
HP HEATER 9A/9B DRAIN TO HP HEATER 8A/8B U/S CV	SA 106 Gr C	168.3 x 10.97
HP HEATER 9A/9B DRAIN TO HP HEATER 8A/8B D/S CV	SA 106 Gr C	168.3 x 10.97
HP HEATER 9A/9B ALT. DRAIN TO FLASH TANK-A/B U/S CV	SA 106 Gr C	168.3 x 10.97
HP HEATER 9A/9B ALT. DRAIN TO FLASH TANK-A/B D/S CV	SA 106 Gr C	219.1 x 25
HP HEATER 8A/8B DRAIN TO HP HEATER 7A/7B U/S CV	SA 106 Gr C	273 x 12.7
HP HEATER 8A/8B DRAIN TO HP HEATER 7A/7B D/S CV	SA 106 Gr C	273 x 12.7
HP HEATER 8A/8B ALT. DRAIN TO FLASH TANK-A/B U/S CV	SA 106 Gr C	273 x 12.7
HP HEATER 8A/8B ALT. DRAIN TO FLASH TANK-A/B D/S CV	SA 106 Gr C	323.9 x 14.27
HPH 7A / 7B DRN TO DEAERATOR (U/S OF CV)	SA 106 Gr C	273 x 12.7
HPH 7A / 7B DRN TO DEAERATOR (D/S OF CV)	SA 106 Gr C	273 x 12.7
HPH 7A / 7B ALT DRN TO F/T-B (U/S OF CV)	SA 106 Gr C	273 x 12.7
HPH 7A / 7B ALT DRN TO F/T-B (D/S OF CV)	SA 106 Gr C	323.9 x 12.7

LPH 5 DRN TO LPH 4 (U/S OF CV)	SA 106 Gr B	168.3 x 7.11
LPH 5 DRN TO LPH 4 (D/S OF CV)	SA 106 Gr B	219.1 x 6.35
LPH 5 ALT DRN TO F/T-A (U/S OF CV)	SA 106 Gr B	168.3 x 7.11
LPH 5 ALT DRN TO F/T-A (D/S OF CV)	SA 106 Gr B	219.1 x 12.5
LPH 4 DRN TO LPH-3 (U/S OF CV)	SA 106 Gr B	219.1 x 6.35
LPH 4 DRN TO LPH 3 (D/S OF CV)	SA 106 Gr B	219.1 x 6.35
LPH-4 ALT DRN TO F/T-A (U/S OF CV)	SA 106 Gr B	168.3 x 7.11
LPH-4 ALT DRN TO F/T-A (D/S OF CV)	SA 106 Gr B	219.1 x 12.5
LP HEATER 3 TO DRIP PUMP SUCTION LINE	SA 106 Gr B	273 x 9.27
LPH-3 EMERGENCY DRAIN U/S CV	SA 106 Gr B	273 x 9.27
LPH-3 EMERGENCY DRAIN D/S CV	SA 106 Gr C	323.9 x 9.53
LPH 2 DRN TO LPH 1	SA 106 Gr B	168.3 x 7.11
LPH-2 ALT DRN TO F/T-A	SA 106 Gr B	219.1 x 12.5
LPH-2 ALT DRN TO F/T-A LINE VENT	SA 106 Gr B	33.4 x 4.55
LPH 1 DRN TO DRN COOLER	SA 106 Gr B	168.3 x 7.11
DRN COOLER OUTLET TO F/T-A	SA 106 Gr B	219.1 x 6.35
DRN COOLER TO F/T-A LINE VENT	SA 106 Gr B	33.4 x 4.55
GSC DRN TO F/T-A	SA 106 Gr B	88.9 x 5.49
GSC DRN TO F/T-A BYPASS	SA 106 Gr B	60.3 x 5.54
GSC SEALING STEAM CONNECTION VENTING TO ATMOSPHERE	SA 106 Gr B	355.6 x 9.53
GSC SEALING STEAM CONNECTION VENTING TO ATMOSPHERE SYPHON	SA 106 Gr B	60.3 x 5.54
DRN MANIFOLDS TO F/T-A	SA 106 Gr B	219.1 x 8.18
DRN MANIFOLDS TO F/T-A	SA 106 Gr B	219.1 x 8.18
F/T-A DRN LINE TO CONDENSER	SA 106 Gr B	508 x 16
F/T-B DRAIN TO CONDENSER	SA 106 Gr C	323.9 x 9.53
DRN MANIFOLD TO F/T-B	SA 106 Gr B	219.1 x 8.18
DRN MANIFOLD TO F/T-B	SA 106 Gr B	219.1 x 8.18
SPARE CONNECTION ON F/T-B	SA 106 Gr B	168.3 x 7.11
SPARE CONNECTION ON F/T-B	SA 106 Gr B	219.1 x 8.18
SPARE CONNECTION ON F/T-B	SA 106 Gr B	33.4 x 4.55
F/T-B VENT TO CONDENSER	SA 672 B70	813 x 10
F/T-A VENT TO CONDENSER	SA 672 B70	813 x 10
HPH 9A/9B INDIVIDUAL VENT TO F/T B	SA 106 Gr B	60.3 x 5.54
HPH 8A/8B INDIVIDUAL VENT TO F/T B	SA 106 Gr B	60.3 x 5.54
HPH 7A/7B INDIVIDUAL VENT TO F/T B	SA 106 Gr B	60.3 x 5.54
LPH 5 VENT TO CONDENSER '1'	SA 106 Gr B	114.3 x 6.02
LPH 4 VENT TO CONDENSER '1'	SA 106 Gr B	114.3 x 6.02

LPH 3 VENT TO CONDENSER '1'	SA 106 Gr B	114.3 x 6.02
LPH 1 & 2 VENT TO CONDENSER	SA 106 Gr B	168.3 x 7.11
D/A START-UP VENT	SA 106 Gr B	60.3 x 5.54
D/A VENT TO ATMOSPHERE	SA 106 Gr B	60.3 x 5.54
HPH-9A/9B START-UP VENT	SA 106 Gr B	33.4 x 4.55
HPH-8A/8B START-UP VENT	SA 106 Gr B	33.4 x 4.55
HPH 7A/7B START UP VENT	SA 106 Gr B	33.4 x 4.55
HPH 9A/9B INDIVIDUAL VENT TO F/T B	SA 106 Gr B	168.3 x 7.11
LPH 5 START UP VENT	SA 106 Gr B	33.4 x 4.55
LPH 4 START UP VENT	SA 106 Gr B	33.4 x 4.55
LPH 3 START UP VENT	SA 106 Gr B	33.4 x 4.55
LPH 1 & 2 START UP VENT	SA 106 Gr B	33.4 x 4.55
SG STARTUP DRAIN TO FT-A	SA 106 Gr C	406.4 x 9.53
DEAERATOR COMMON VENT HEADER	SA 106 Gr B	114.3 x 6.02
D/A OVERFLOW TO F/T-B (D/S OF CV)	SA 106 Gr C	323.9 x 9.53
F/T-A/B DRAIN LINE TO CONDENSER DRAIN	SA 106 Gr B	33.4 x 4.55
DEAERATOR SRV INLET (HEATER PART)	SA 106 Gr C	168.3 x 10.97
DEAERATOR SRV OUTLET (HEATER PART)	SA 106 Gr C	273 x 6.35
DEAERATOR SRV OUTLET (HEATER PART)	SA 106 Gr B	355.6 x 9.53
SRV OUTLET COLLECTION PLATE DRAIN (HEATER PART)	SA 106 Gr B	33.4 x 4.55
DEAERATOR SRV INLET (TANK PART)	SA 106 Gr B	219.1 x 12.7
DEAERATOR SRV OUTLET (TANK PART)	SA 106 Gr B	273 x 6.35
DEAERATOR SRV INLET (TANK PART)	SA 106 Gr B	355.6 x 9.53
SRV OUTLET COLLECTION PLATE DRAIN (TANK PART)	SA 106 Gr B	33.4 x 4.55
FEED WATER SYSTEM		
BOOSTER PUMP-A/B SUCTION LINE	SA 106 Gr C	406.4 x 9.53
BOOSTER PUMP-C SUCTION LINE	SA 106 Gr C	323.9 x 9.53
FOR SAMPLING AT BOOSTER PUMP-A/B/C SUCTION	SA 312 TP 304	33.4 x 3.38
BOOSTER PUMP A/B/C SUCTION RELIEF VALVE INLET	SA 106 Gr B	33.4 x 4.55
BOOSTER PUMP A/B/C SUCTION RELIEF VALVE OUTLET	SA 106 Gr B	60.3 x 5.54
STUB FOR AMMONIA DOSING AT BFP SUCTION LINE	SA 312 TP 304	33.4 x 3.38

STUB FOR OXYGEN DOSING AT BFP SUCTION LINE	SA 312 TP 304	21.3 x 2.77
BOOSTER PUMP-A/B DISCHARGE TO BFP	SA 106 Gr C	406.4 x 9.53
BOOSTER PUMP-C DISCHARGE TO BFP	SA 106 Gr C	323.9 x 9.53
BFP-A/B RECIRCULATION LINE TO DEA.	SA 106 Gr C	323.9 x 62
BFP-C RECIRCULATION LINE TO DEA.	SA 106 Gr C	273 x 55
BFP-A/B RECIRCULATION LINE NEAR TO DEA.	SA 106 Gr C	219.1 x 8.18
BFP-C RECIRCULATION LINE NEAR TO DEA.	SA 106 Gr B	168.3 x 7.11
BFP-A/B DISCHARGE LINE	SA 106 Gr C	457 x 90
BFP-C DISCHARGE LINE	SA 106 Gr C	355.6 x 70
BFP DISCHARGE HEADER UPTO FEED CONTROL STATION	SA 106 Gr C	610 x 116
TO LOW LOAD FC STATION UPTO IST ISOLATION D/S OF CV	SA 106 Gr C	355.6 x 70
LOW LOAD FC STATION D/S OF ISOLATION VALVE	SA 106 Gr C	323.9 x 56
BFP DISCHARGE HEADER AFTER FEED CONTROL STATION	SA 106 Gr C	610 x 90
FEED DISCH. INLET TO HPH-7A / 7B	SA 106 Gr C	406.4 x 60
FEED DISCH. FROM HPH-7A / 7B TO HPH-8A / 8B	SA 106 Gr C	406.4 x 60
FEED DISCH. FROM HPH-8A / 8B TO HPH-9A / 9B	SA 106 Gr C	406.4 x 60
FEED DISCH. FROM HPH-9A / 9B OUTLET TO HEADER	SA 106 Gr C	406.4 x 60
HPH 50% BYPASS LINE	SA 106 Gr C	406.4 x 60
HPH 50% BYPASS LINE	SA 106 Gr C	406.4 x 60
FEED DISCH. HEADER TO ECONOMISER INLET	SA 106 Gr C	ID 405 x 70
HP BYPASS SPRAY FROM BFP DISCH	SA 106 Gr C	168.3 x 27.5
BFP-A/B DISCH. TO RH SPRAY	SA 106 Gr C	114.3 x 17.12
BFP-C DISCH. TO RH SPRAY	SA 106 Gr C	88.9 x 11.13
RH SPRAY HEADER	SA 106 Gr C	168.3 x 21.95
BFP HP STAGE LEAK-OFF LINE	SA 106 Gr C	60.3 x 5.54
BOOSTER PUMP TO BFP INDIVIDUAL WARMING UP LINE	SA 106 Gr C	48.3 x 7.14

BFP INDIVIDUAL WARMING UP LINE D/S OF NRV	SA 106 Gr C	48.3 x 11
BFP WARMING UP HEADER	SA 106 Gr C	60.3 x 8.74
FEED DISCH. HEADER TO ECONOMISER INLET LINE DRAIN & VENT	SA 106 Gr C	33.4 x 9.09
DRAINS & VENT ON FEED DISCH. HDR UPTO IST ISOLATION VALVE OF LOW LOAD FCV	SA 106 Gr C	33.4 x 9.09
BFP RECRICULATION LINE DRAIN UPTO ISOLATION VALVE	SA 106 Gr C	33.4 x 9.09
BFP RECIRCULATION LINE VENT NEAR DEAERATOR	SA 106 Gr B	33.4 x 4.55
BP SUCTION LINE DRAIN/VENT	SA 106 Gr B	33.4 x 4.55
40 NB DRAINS OF FEED WATER SYSTEM	SA 106 Gr C	48.3 x 10.15
BFP SUCTION LINE DRAIN/VENT	SA 106 Gr B	33.4 x 4.55
RH SPRAY LINE DRAIN/VENTS	SA 106 Gr C	33.4 x 6.35
CONDENSATE SYSTEM		
COND. FROM HOTWELL TO CEP SUCTION HEADER	SA 106 Gr B	323.9 x 6.35
HOTWELL DRAIN	SA 106 Gr B	114.3 x 6.02
CEP COND. SUCTION HEADER	SA 106 Gr C	660 x 22
CEP-A/B/C RELIEF VALVE DISCH	SA 106 Gr B	60.3 x 5.54
CEP A/B/C SUCTION LINE	SA 106 Gr B	457 x 9.53
CEP SUCTION SIDE DRAIN	SA 106 Gr B	33.4 x 4.55
CEP-A/B/C DISCH. ELBOW VENT TO F/T-A	SA 106 Gr B	33.4 x 4.55
CEP A/B/C DISCH. LINE	SA 106 Gr C	273 x 12.7
CEP A/B/C DISCH. VALVE BYPASS	SA 106 Gr B	88.9 x 5.49
CEP A/B/C RECIRCULATION LINE	SA 106 Gr B	168.3 x 7.11
COND. LINE FROM CEP TO GSC	SA 106 Gr B	355.6 x 9.53
COND. LINE FROM GSC TO CPU	SA 106 Gr B	355.6 x 9.53
COND. FROM COND. POLISHING UNIT	SA 106 Gr B	355.6 x 9.53
CPU RINSE TO HOTWELL (CPU VENDOR SCOPE)	SA 106 Gr B	168.3 x 7.11
GSC/CEP MIN. FLOW REC. LINE	SA 106 Gr B	168.3 x 7.11
GSC/CEP MIN. FLOW REC. BYPASS LINE	SA 106 Gr B	168.3 x 7.11
CONTAMINATED COND. TO WASTE	SA 106 Gr C	273 x 12.7
COND. HEADER FOR LPBP EXHAUST HOOD & TUR FB SPR & CONDENSATE DUMP	SA 106 Gr C	273 x 12.7

COND. TO EXCESS RTRN LPBP EXHAUST HOOD & TUR FB SPR	SA 106 Gr C	273 x 12.7
EXCESS CONDENSATE DUMP	SA 106 Gr C	219.1 x 8.18
EXCESS CONDENSATE DUMP CONTROL STATION D/S	SA 106 Gr B	219.1 x 6.35
EXCESS CONDENSATE DUMP CONTROL STATION BYPASS	SA 106 Gr B	168.3 x 7.11
MAIN CONDENSATE CONTROL STATION BYPASS LINE	SA 106 Gr C	219.1 x 8.18
MAIN COND CONTROL TO DRAIN COOLER	SA 106 Gr B	355.6 x 9.53
COND. FROM DRAIN COOLER TO LPH-1	SA 106 Gr B	355.6 x 9.53
COND. FROM LPH-1 TO LPH-2	SA 106 Gr B	355.6 x 9.53
COND. FROM LPH-2 TO LPH-3	SA 106 Gr B	355.6 x 9.53
LPH 1/2 BYPASS LINE	SA 106 Gr B	355.6 x 9.53
COND. FROM LPH 3 TO LPH 4 UPTO DRIP PUMP CONNECTION	SA 106 Gr B	355.6 x 9.53
COND. FROM LPH 3 TO LPH 4 AFTER DRIP PUMP CONNECTION	SA 106 Gr C	406.4 x 9.53
LPH 3 BYPASS LINE	SA 106 Gr B	355.6 x 9.53
COND. FROM LPH 4 TO LPH-5	SA 106 Gr C	406.4 x 9.53
LPH 4 BYPASS LINE	SA 106 Gr C	406.4 x 9.53
COND. FROM LPH 5 TO D/A	SA 106 Gr C	406.4 x 9.53
LPH 5 BYPASS LINE	SA 106 Gr C	406.4 x 9.53
COND. FROM LPH 5 TO D/A (HALF FLOW)	SA 106 Gr C	273 x 12.7
LP HEATER 3 TO DRIP PUMP SUCTION LINE	SA 106 Gr B	273 x 9.27
DRIP PUMP DISCHARGE LINE	SA 106 Gr B	168.3 x 7.11
DRIP PUMP DISCHARGE BYPASS CV	SA 106 Gr B	168.3 x 7.11
DRIP PUMP RECIRCULATION	SA 106 Gr B	88.9 x 5.49
CEP DISCH. TO CEP STUFFING BOX SEALING	SA 106 Gr B	33.4 x 4.55
FROM DM MU PUMP DISCH. TO CEP STUFFING BOX SEALING	SA 312 TP 304	33.4 x 3.38
COND. FOR VALVE GLAND SEALING ETC	SA 106 Gr B	114.3 x 6.02
COND. FOR VALVE GLAND SEALING ETC	SA 106 Gr B	60.3 x 5.54
COND. FOR VALVE GLAND SEALING (D/S OF CV)	SA 106 Gr B	60.3 x 5.54
VLV GLNS SLG HDR CONTROL STATION B/P LINE	SA 106 Gr B	60.3 x 5.54
CEP DISCH SPRAY TO F/T-A	SA 106 Gr B	60.3 x 5.54

CEP DISCH SPRAY TO F/T-B	SA 106 Gr B	60.3 x 5.54
MU WATER TO VACUUM PUMPS	SA 106 Gr B	33.4 x 4.55
TO BFP DRIVE TURBINE EXHAUST HOOD SPRAY	SA 106 Gr B	33.4 x 4.55
VACUUM BREAKER VALVE OUTLET FILLING	SA 106 Gr B	33.4 x 4.55
VALVE SEALING HEADER	SA 106 Gr B	33.4 x 4.55
TO VALVE SEALING FOR VAC. GLAND SEALING	SA 106 Gr B	21.3 x 3.73
COND. TO BOILER R/C PUMP MOTOR LP FILL	SA 106 Gr B	33.4 x 4.55
TO STATOR WATER COOLING SYSTEM MAKE UP FILLING	SA 312 TP 304	SA 312 TP 304
COND. TO AMMONIA DOSING	SA 106 Gr B	33.4 x 4.55
SPARE TAPPING	SA 106 Gr B	33.4 x 4.55
SPARE TAPPING	SA 106 Gr B	48.3 x 7.14
SPARE TAPPING	SA 106 Gr B	60.3 x 5.54
AMMONIA DOSING AT CEP DISCH.	SA 312 TP 304	33.4 x 3.38
OXYGEN DOZING AT CEP DISCH. (VENDOR SCOPE)	SA 312 TP 304	21.3 x 2.77
EMERGENCY MAKE UP TO HOTWELL(UNIT1/2)	SA 312 TP 304 (ERW)	219.1 x 3.76
NORMAL MAKE UP TO HOTWELL (UNIT1/2)	SA 312 TP 304 (ERW)	114.3 x 3.05
D/A OVER FLOW LINE	SA 106 Gr B	219.1 x 6.35
D/A OVERFLOW TO F/T-B (D/S OF CV)	SA 106 Gr C	323.9 x 9.53
D/A DRN TO F/T-B UPTO ISOLATION VALVE	SA 106 Gr B	168.3 x 7.11
D/A DRN TO TRENCH	SA 106 Gr B	168.3 x 7.11
LINE FROM COND. TO VACUUM PUMP (INDIV. LINE)	SA 106 Gr B	219.1 x 6.35
LINE FROM COND. TO VACUUM PUMP (COMMON LINE)	SA 106 Gr C	323.9 x 9.53
CEP A/B/C VAPOUR AIR MIXTURE LINE TO CONDENSER	SA 106 Gr B	60.3 x 5.54
BOILER FILLING LINE FROM CEP DISCH HEADER	SA 106 Gr B	168.3 x 7.11
DEAERATOR & BOILER FILLING LINE FROM BOILER FILL PUMP AT TP WITH WS SCOPE	SA 312 TP 304	168.3 x 3.4
DEAERATOR & BOILER FILLING LINE TO INDIVIDUAL UNIT-1 & 2	SA 312 TP 304	168.3 x 3.4

DEAERATOR FILLING LINE FROM BOILER FILL PUMP	SA 312 TP 304	114.3 x 3.05
BOILER FILLING LINE FROM BOILER FILL PUMP	SA 312 TP 304	168.3 x 3.4
DM WATER FOR VALVE GLA SEALING FORM CONDENSATE TRF PUMP (UPTO NRV)	SA 312 TP 304	60.3 x 3.91
DM WATER FOR VALVE GLA SEALING FORM CONDENSATE TRF PUMP D/S NRV)	SA 106 Gr B	60.3 x 5.54
DM MU PUMP DISCHARGE HEADER TO STATOR WATER COOLING	SA 312 TP 304	33.4 x 3.38
DRIP PUMP VENT TO LPH-3	SA 106 Gr B	33.4 x 4.55
AUXILIARY STEAM SYSTEM (MISCELLANEOUS)		
STUB FOR AUX PRDS SPRAY FROM CEP DISCHARGE HEADER	SA 106 Gr B	88.9 x 5.49
AS TO MAIN TURBINE GLAND SEALS	SA 106 Gr B	88.9 x 5.49
TURBINE GLND SEALING DRAIN TO F/T-B	SA 106 Gr B	48.3 x 7.14
AUX. STEAM FOR DEA PEGGING (U/S OF CV)	SA 106 Gr C	219.1 x 6.35
AUX STM TO BFPT & GLAND SEALING	SA 106 Gr B	219.1 x 6.35
STEAM DRAINS SYSTEM		
TURBINE GLND SEALING DRAIN TO F/T-B	SA 106 Gr B	48.3 x 7.14
AS TO TUR GS DRN TO F/T-B (BYPASS LINE)	SA 106 Gr B	48.3 x 7.14
EXTN TO HPH-7A&7B DRAIN POT DRAIN TO FLASH TANK-B	SA 335 P22	60.3 x 5.54
DRN MANIFOLD-1 TO F/T-B	SA 106 Gr C	219.1 x 8.18
EXTN TO HPH-9A/B COMMON LINE DRN POT DRAIN TO F/T-B	SA 335 P22	60.3 x 5.54
EXTN TO DEA DRN POT TO F/T-B	SA 106 Gr B	33.4 x 4.55
EXTN TO DEA DRN POT TO F/T-B (BYPASS LINE)	SA 106 Gr B	33.4 x 4.55
EXTRN TO BFPT A/B DRN POT DRN TO F/T-B	SA 106 Gr B	33.4 x 4.55
EXTRN TO BFPT A/B DRN POT DRN TO F/T-B (BYPASS LINE)	SA 106 Gr B	33.4 x 4.55
EXT STEAM TO BFPT B LINE DRN POT TO F/TB (D/S OF CV)	SA 106 Gr B	33.4 x 4.55

EXT STEAM TO BFPT B LINE DRN BYPASS (D/S OF CV)	SA 106 Gr B	33.4 x 4.55
EXTN TO LPH-5 DRIP LEG DRAIN TO F/T-B	SA 106 Gr B	60.3 x 5.54
STUB FOR CRH NRV D/S LINE DRAIN POT DRAIN TO FLASH TANK-B	SA 106 Gr B	88.9 x 7.62
STUB FOR CRH NRV U/S LINE DRAIN POT DRAIN TO FLASH TANK-B	SA 106 Gr C	60.3 x 5.54
DRN MANIFOLD-2 TO F/T-B	SA 106 Gr C	219.1 x 8.18
2 NOS STUBS FOR LP BYPASS LINE DRAIN POT DRAIN TO FLASH TANK B	SA 106 Gr B	60.3 x 5.54
CRH NRV VALVE DRAIN LINE	SA 106 Gr B	60.3 x 5.54
CRH TO BFPT A & B COMMON LINE DRN POT DRN TO F/T-A U/S CS	SA 106 Gr C	33.4 x 6.35
CRH TO BFPT-A & B COMMON LINE DRAIN BYPASS	SA 106 Gr C	33.4 x 6.35
EXT STEAM TO BFPT A DRN POT DRN(D/S OF CS) TO F/T-A	SA 106 Gr B	33.4 x 4.55
EXT STEAM TO BFPT A LINE DRN BYPASS	SA 106 Gr B	33.4 x 4.55
CRH TO DEA PGG LINE (D/S OF CS) DRN POT TO F/T-A	SA 106 Gr B	33.4 x 4.55
CRH TO DEA PEGGING LINE DRAIN (BYPASS LINE)	SA 106 Gr B	33.4 x 4.55
AUX STEAM TO BFPT A/B LINE DRN POT DRN TO F/T-A	SA 106 Gr B	33.4 x 4.55
AUX STEAM TO BFPT A/B LINE DRN BYPASS	SA 106 Gr B	33.4 x 4.55
DRN MANIFOLD-1 TO F/T-B	SA 106 Gr C	219.1 x 8.18
DRN MANIFOLD-2 TO F/T-B	SA 106 Gr C	219.1 x 8.18
2 NOS SPARE STUBS ON DRAIN MANIFOLD-1 TO F/T B	SA 106 Gr C	60.3 x 5.54
2 NOS SPARE STUBS ON DRAIN MANIFOLD-2 TO F/T B	SA 106 Gr C	60.3 x 5.54
2 NOS STUB FOR MS STOP VALVE SPINDLE LEAK OFF LINE TO UNIT FLASH TANK	SA 335 P22	60.3 x 5.54
2 NOS STUB FOR MS LINE DRAIN TO UNIT FLASH TANK	SA 335 P22	168.3 x 10.97
2 NOS STUB FOR MS LINE ALTERNATE DRAIN TO FLASH TANK-B	SA 335 P22	88.9 x 7.62
2 NOS STUB FOR MS STOP VALVE WARMING UP TO UNIT FLASH TANK	SA 335 P22	60.3 x 5.54

2 NOS STUB FOR HRH LINE DRAIN TO FLASH TANK-B	SA 335 P92	88.9 x 7.62
2 NOS STUB FOR HRH LINE ALTERNATE DRAIN TO UNIT FLASH TANK	SA 335 P92	88.9 x 7.62
2 NOS STUB FOR IPT STOP VALVE WARMING UP TO UNIT FLASH TANK	SA 335 P92	88.9 x 7.62
2 NOS SPARE STUBS ON DRAIN MANIFOLD TO UFT	SA 335 P22	60.3 x 5.54
DRN MANIFOLD TO UNIT FLASH TANK	SA 335 P22	323.9 x 9.0
UNIT F/T VENT TO ATM.	SA 106 Gr C	406.4 x 9.53
UNIT F/T DRAIN TO DRAIN TRENCH	SA 106 Gr B	219.1 x 6.35
SPRAY TO UNIT F/T FROM SERVICE WATER	SA 106 Gr B	33.4 x 4.55
SPARE CONNECTION ON UFT	SA 335 P22	219.1 x 12.7
AS TO MAIN TURBINE GLAND SEALS	SA 106 Gr B	88.9 x 5.49
EXTRACTION STEAM TO BFPT		
AUX STM TO BFPT & GLAND SEALING	SA 106 Gr B	219.1 x 6.35
AUX STEAM TO BFPT A/B LINE DRIP LEG	SA 106 Gr B	114.3 x 6.02
AUX STM TO BFPT A/B	SA 106 Gr B	219.1 x 6.35
AUX STM TO BFPT A/B (D/S OF SCNRV)	SA 106 Gr C	219.1 x 12.5
AUX STEAM TO BFPT-A/B LINE DRAIN TO FLASH TANK-A	SA 106 Gr B	33.4 x 4.55
AUX STM TO BFPT A/B GLAND SEALING	SA 106 Gr B	48.3 x 7.14
CRH TO BFPT COMMON LINE	SA 106 Gr C	273 x 15.09
CRH TO BFPT A/B U/S CV	SA 106 Gr C	273 x 15.09
CRH TO BFPT A/B D/S CV	SA 106 Gr C	323.9 x 9.53
CRH TO BFPT A/B WARM UP LINE	SA 106 Gr C	33.4 x 6.35
CRH TO BFPT A DRIP LEG U/S CV	SA 106 Gr C	114.3 x 17.12
CRH TO BFPT A/B DRIP LEG D/S CV	SA 106 Gr B	114.3 x 6.02
CRH TO BFPT A/B DRN POT DRN TO F/T A/B U/S CS	SA 106 Gr C	33.4 x 6.35
CRH TO BFPT A/B DRN POT DRN TO F/T A/B D/S CS	SA 106 Gr B	33.4 x 4.55
EXTRN LINE TO BFP TURBINES (COMMON LINE)	SA 106 Gr B	508 x 16
EXTRN TO BFPT A/B (UPTO SCNRV)	SA 106 Gr B	355.6 x 9.53
EXTRN TO BFPT A/B (D/S OF SCNRV)	SA 106 Gr B	355.6 x 9.53
EXTRN TO BFPT A/B (HALF FLOW NEAR BFPT)	SA 106 Gr B	273 x 9.27

BFPT EXHAUST LINE VENT	SA 106 Gr C	323.9 x 9.53
EXTRN TO BFPT A/B DRIP LEG	SA 106 Gr B	219.1 x 6.35
EXTRN TO BFPT A/B DRN POT DRN TO F/T A/B	SA 106 Gr B	33.4 x 4.55
PROVISION FOR WET STM WASHING	SA 106 Gr B	88.9 x 5.49
BFPT START UP VENT OUTSIDE TG HALL	SA 106 Gr B	60.3 x 5.54
BFPT START UP VENT OUTSIDE TG HALL D/S OF VENT VAL	SA 106 Gr B	168.3 x 7.11
EXV-25 & 26 BYPASS	SA 106 Gr B	60.3 x 5.54
CENTRAL LUBE OIL SYSTEM		
CLEAN OIL PUMP DISCHARGE	SA 106 Gr B	88.9 x 5.49
DIRTY OIL PUMP DISCHARGE TO PURIFIER	SA 106 Gr B	88.9 x 5.49
CLEAN OIL TO CLEAN OIL HEADER	SA 106 Gr B	88.9 x 5.49
CLEAN OIL TANK INITIAL FILLING	SA 106 Gr B	88.9 x 5.49
PURIFIER RECIRCULATION LINE TO DO TANK	SA 106 Gr B	88.9 x 5.49
PURIFIER OUTLET TO CLEAN OIL HEADER	SA 106 Gr B	88.9 x 5.49
OIL FILLING LINE FROM OIL UNLOADING VESSEL	SA 106 Gr B	88.9 x 5.49
DIRTY OIL TANK OUTLET	SA 106 Gr B	88.9 x 5.49
DIRTY OIL TANK NORMAL OUTLET	SA 106 Gr B	88.9 x 5.49
MAIN OIL TANK TO DIRTY OIL HEADER	SA 312 TP 304 (ERW)	88.9 x 3.05
DIRTY OIL PUMP SUCTION	SA 106 Gr B	88.9 x 5.49
CLEAN OIL PUMP SUCTION	SA 106 Gr B	88.9 x 5.49
CLEAN OIL TANK OUTLET	SA 106 Gr B	88.9 x 5.49
CLEAN OIL TANK NORMAL OUTLET	SA 106 Gr B	88.9 x 5.49
BFPT A/B RESERVOIR INLET	SA 312 TP 304 (ERW)	33.4 x 3.38
BFPT A/B RESERVOIR OUTLET	SA 312 TP 304 (ERW)	33.4 x 3.38
CLEAN OIL HEADER TO MAIN OIL TANK	SA 312 TP 304 (ERW)	88.9 x 3.05
INTERCONN. DOP AND COP SUCTION	SA 106 Gr B	88.9 x 5.49
INTERCONN. DOP AND COP DISCHARGE	SA 106 Gr B	88.9 x 5.49
SAMPLING CONNECTION FROM LUBE OIL PURIFIER	SA 106 Gr B	33.4 x 4.55
CONNECTION ON DO PUMP OUTLET FOR FLEXIBLE HOSE	SA 106 Gr B	60.3 x 5.54

CONNECTION ON CO PUMP OUTLET FOR FLEXIBLE HOSE	SA 106 Gr B	60.3 x 5.54
SAMPLING CONNECTION FROM DIRTY OIL TANK	SA 106 Gr B	33.4 x 4.55
SAMPLING CONNECTION FROM CLEAN OIL TANK	SA 106 Gr B	33.4 x 4.55
DIRTY OIL PUMP DISCHARGE TO DO TANK FILLING	SA 106 Gr B	88.9 x 5.49
DIRTY OIL HEADER	SA 312 TP 304 (ERW)	88.9 x 3.05
CLEAN OIL HEADER	SA 312 TP 304 (ERW)	88.9 x 3.05
DIRTY OIL HEADER TO DIRTY OIL STORAGE TANK	SA 106 Gr B	88.9 x 5.49
CENTRAL OIL PURIFIER INLET	SA 106 Gr B	88.9 x 5.49
DIRTY OIL PUMP DISCHARGE	SA 106 Gr B	88.9 x 5.49
CONDENSATE TRANSFER SYSTEM		
DM WATER SUPPLY HEADER FROM WS SCOPE (TP-15)	SA 312 TP 304 (ERW)	168.3 x 3.4
INLET TO CST-1/2	SA 312 TP 304 (ERW)	114.3 x 3.05
OUTLET OF CST-1/2	SA 312 TP 304 (ERW)	273 x 4.19
CONDENSATE TRANSFER PUMP SUCTION HEADER	SA 312 TP 304 (ERW)	273 x 4.19
CONDENSATE TRANSFER PUMP INDIVIDUAL SUCTION	SA 312 TP 304 (ERW)	273 x 4.19
CONDENSATE TRANSFER PUMP DISCHAGE	SA 312 TP 304 (ERW)	219.1 x 3.76
CONDENSATE TRANSFER PUMP RECIRCULATION LINE	SA 312 TP 304 (ERW)	114.3 x 3.05
CONDENSATE TRANSFER PUMP RECIRCULATION TO CST-1/2	SA 312 TP 304 (ERW)	114.3 x 3.05
CONDENSATE TRANSFER PUMP DISCHARGE HEADER	SA 312 TP 304 (ERW)	219.1 x 3.76
EXCESS CONDENSATE RETURN HDR	SA 106 Gr B	219.1 x 6.35
EXCESS CONDENSATE RETURN TO CST-1/2	SA 106 Gr C	219.1 x 8.18

EMERGENCY MAKE UP CONTROL STATION (UNIT1/2)	SA 312 TP 304 (ERW)	219.1 x 3.76
BYPASS TO EMERGENCY MAKE UP CONTROL STATION	SA 312 TP 304 (ERW)	168.3 x 3.4
EMERGENCY MAKE UP TO HOTWELL(UNIT1/2)	SA 312 TP 304 (ERW)	219.1 x 3.76
DM WATER SUPPLUY HEADER FROM TRANSFER PUMP HEADER	SA 312 TP 304	60.3 x 3.91
DM WATER FOR CEP SEALING	SA 312 TP 304	33.4 x 3.38
DM WATER FOR VALVE GLAND SEALING	SA 312 TP 304	60.3 x 3.91
EMERGENCY MAKE-UP TO ECW O/H TANK	SA 312 TP 304	60.3 x 3.91
DM WATER FOR CHEMICAL DILUTION	SA 312 TP 304	33.4 x 3.38
EMERGENCY SUPPLY TO LP DOSING & ECW OH TANK (SG AREA)	SA 312 TP 304	60.3 x 3.91
NORMAL MAKE-UP LINE FROM DM MAKE-UP PUMP	SA 312 TP 304 (ERW)	168.3 x 3.4
NORMAL MAKE UP CONTROL STATION (UNIT 1/2)	SA 312 TP 304 (ERW)	114.3 x 3.05
BYPASS TO NORMAL MAKE UP CONTROL STATION	SA 312 TP 304 (ERW)	88.9 x 3.05
NORMAL MAKE UP TO HOTWELL (UNIT1/2)	SA 312 TP 304 (ERW)	114.3 x 3.05
NORMAL MAKE-UP LINE FROM DM MAKE-UP PUMP TO UNIT-2	SA 312 TP 304 (ERW)	168.3 x 3.4
NORMAL MAKE-UP TO ECW OH TANK	SA 312 TP 304	60.3 x 3.91
DM WATER TO STATOR WATER COOLING	SA 312 TP 304	33.4 x 3.38

SUGGESTED BOM FOR PRE-BOILER FLUSHING AND FEED LINE CITRIC ACID FLUSHING
KHURJA 2X660 MW

SR NO.	DESCRIPTION	MATERIAL SPECN	QTY	AREA
1	PIPE Ø 406.4 X 12.7	SA 106 GR B	30 m	Pump Suction header, suction line from tank to header
2	PIPE Ø 355.6 X 9.53	SA 106 GR B	20 m	GSC bypass temp line.
3	PIPE Ø 323.9 X 9.57	SA 106 GR B	30 m	Pump discharge header, each pump suction line
4	PIPE Ø 273 X 9.1	SA 106 GR B	700 m	Each pump discharge line, System I/L & O/L, loop lines near deaerator

5	PIPE Ø 219.1 X 8.18	SA 106 GR B	350 m	Pump discharge lines, loop lines in drip system, LPBP spray, tank overflow line
6	PIPE Ø 168.3 X 7.11	SA 106 GR B	300 m	Loop lines in drip system, Pump Recirculation line, DM water supply line
7	PIPE Ø 114.3 X 6.02	SA 106 GR B	300 m	Steam supply supply
8	PIPE Ø 88.9 X 5.49	SA 106 GR B	50m	Heater drain near tank,
9	PIPE Ø 48.3 X 5.08	SA 106 GR B	200 m	Drain lines, pump gland cooling header, CC pump suction manifold drain line, sample cooler cooling water line
10	PIPE Ø 33.4X 3.38	SA 106 GR B	250 m	Drain lines, heater coil, air lines in pit
11	PIPE Ø 21.3 X 3.73	SA 106 GR B	100 m	Vent lines, sampling lines, pump gland cooling lines
12	PIPE Ø 273.1 X 9.1	API 5LGRB (ERW)	1500 m	System drain to neutralising pit
13	ASME B16.9 BW LR 90DEG ELBOW Ø406.4 X 12.7	SA 234 WPB	03 nos.	
14	ASME B16.9 BW LR 90DEG ELBOW Ø355.6 X 9.53	SA 234 WPB	4 nos	GSC bypass temp line.
15	ASME B16.9 BW LR 90DEG ELBOW Ø 168.3 X 7.11	SA 234 WPB	15 nos.	
16	ASME B16.9 BW LR 90DEG ELBOW Ø 219.1 X 8.18	SA 234 WPB	15 nos.	
17	ASME B16.9 BW LR 90DEG ELBOW Ø 114.3 X 6.02	SA 234 WPB	15 nos.	
18	ASME B16.9 BW LR 90DEG ELBOW Ø 273 X 9.1	SA 234 WPB	15 nos.	
19	ASME B16.9 BW EQ TEE ELBOW Ø 273 X 9.1	SA 234 WPB	08 nos.	
20	ASME B16.9 BW EQ TEE ELBOW Ø 219.1 X 8.18	SA 234 WPB	06 nos.	
21	SW EQUAL TEE NB - 1.5 INCH CL-800	SA105	03 nos.	
22	ASME B16.9 BW EQ TEE Ø 406.4 X 12.7	SA 234 WPB	02 nos.	
23	ASME B16.9 BW UN EQ TEE Ø 323.9 X 9.57 / Ø 273 X 9.1	SA 234 WPB	06 nos.	
24	ASME B16.9 BW UN EQ TEE Ø 273.9 X 9.1 / Ø 219.1 X 8.18	SA 234 WPB	08 nos.	

25	ASME B16.9 BW UN EQ TEE Ø 323.9 X 9.57 / Ø 168.3 X 7.11	SA 234 WPB	01 no.	
26	ASME B16.9 BW UN EQ TEE Ø 323.9 X 9.57 / Ø 219.1 X 8.18	SA 234 WPB	05 nos.	
27	ASME B16.9 BW UN EQ TEE Ø 273 X 9.1 / Ø 219.1 X 8.18	SA 234 WPB	02 no.	
28	ASME B16.9 BW UN EQ TEE Ø 273 X 9.1 / Ø 168.3 X 7.11	SA 234 WPB	02 no.	
29	SW UNEQUAL TEE NB - 1.5 INCH/0.5 INCH CL-3000	SA105	06 nos.	
30	ASME B16.9 BW REDUCER Ø 323.9 X 9.57 / Ø 273.3 X 9.1	SA 234 WPB	10 nos.	
31	ASME B16.9 BW REDUCER Ø 273.3 X 9.2 / Ø 219.1 X 8.18	SA 234 WPB	12 nos.	
32	ASME B16.9 BW REDUCER Ø 219.1 X 8.18 / Ø 168.3 X 7.11	SA 234 WPB	10 nos.	
33	ASME B16.9 BW REDUCER Ø 168.3 X 7.11 / Ø 114.3 X 6.02	SA 234 WPB	08 nos.	
34	ASME B16.11 SW STUB NB-15 CLASS -3000 (CS)	SA 105	12 nos.	
35	ASME B16.11 SW STUB NB-40 CLASS -800 (CS)	SA 105	04 nos.	
36	PLATE	IS2062 Fe410WA	10 mm X 2 m X 100 m	Storage and mixing Tank fabrication, Blanks, support plate
37	TEMPERATURE STUB M33X2 (CS)	SA105	04 nos.	
38	PR. GAUGES	0-5 BAR	4 NOS	
39	PR. GAUGES	0-25 BAR	6 NOS	
40	TEMPERATURE GAUGES	150°C	4 NOS	
41	PACKING RING M33 X 2	IS 1972	04 nos.	
42	SCREW PLUG M33 X 2	SA 105	08 nos.	
43	CHANNEL 100 mm		100 m	Tank stiffener
44	CHANNEL 150 mm		250 m	Pipe support etc.
45	ISMB BEAM 400 mm, each 10 m length		08 nos	Tank floor support

46	HAND OPERATED GATE VALVE, NB 300, CLASS 300		05 nos.	Pump suction
47	HAND OPERATED GATE VALVE, NB 250, CLASS 300		05 nos.	System I/L & O/L valve, netrailising pit - canal changeover valves
48	NRV, Nb200, CLASS 300		05 nos	Pump discharge
49	HAND OPERATED GATE VALVE, NB 200, CLASS 300		11 nos	Stage isolation valves, pump discharge
50	HAND OPERATED GATE VALVE, NB 150, CLASS 300		05 nos.	Pump Recirculation, DM water supply
51	HAND OPERATED GATE VALVE, NB 100, CLASS 300		03 nos.	Steam supply to heater near tank.
52	HAND OPERATED GATE VALVE, NB 80, CLASS 300		03 nos.	Drain of temporary heater near tank.
53	HAND OPERATED GATE VALVE, NB 50, CLASS 800		10 nos	drain valves
54	HAND OPERATED GATE VALVE, NB 25, CLASS 800		10 nos	drain & vent valves
55	PUMPS ALONGWITH SUITABLE DRIVE MOTOR WITH STARTER , AMMETER, CABLE ETC. WITH MCC AND DISTRIBUTION BOARD	250 Cu M/hr & 20 Kg/cm2	04 sets	
56	PVC HOSE PIPE, 50 MM DIA		approx. 50 m	

Note:

1- Temporary tank and temporary lines to be insulated with at least one layer of LRB wool.

SUGGESTED BOM FOR STEAM BLOWING ACTIVITY - KHURJA 2 x 660 MW

SR NO.	DESCRIPTION	MATERIAL SPECN	QUANTITY	AREA
1.	PIPE Ø 219.1 X 8.18	SA 106 GR B	100 m	TURBINE OVERLOAD LINE & MISC AUX LINES.
2.	ASME B16.9 BW LR 90DEG ELBOW Ø 219.1 X 8.18	SA 234 WPB	10 Nos.	
3.	PIPE Ø 168.3 X 7.11	SA 106 GR B	100 m	
4.	ASME B16.9 BW LR 90DEG ELBOW Ø 168.3 X 7.11	SA 234 WPB	10 Nos.	
5.	Matching Piece ID 200X12.7/ ID 200 X 8.18	SA335P92 to SA335P22	02 Nos.	
6.	Matching Piece ID 150X10.97/ ID 150X7.11	SA335P92 to SA335P22	02 Nos.	
7.	HAND OPERATED VALVE, NB 200	CLASS 1500	1 No.	
8.	ASME B 16.9 BW REDUCER DIA 219.1 X8.18 / 168.3X7.11	SA 234 WPB	1 No.	
9.	HAND OPERATED VALVE NB 450	CLASS 1500	1 No.	
10	UNEQ TEE MS TEMP LINE Ø 457X19.05 TO Ø219.1 X 8.18	SA 234 WPB	1 No.	
11	TARGET PLATE ASSLY Ø 168.3	WELDMENT	1 No.	
12	TARGET PLATES MIRROR FINISH DIA 168.3	SS	40 Nos.	

13	PIPE Ø762X20	SA 106 GR B	100 m	PIPE FROM IV TO EXHAUST
14	FLAT END CLOSURE OD762X45	MS PLATE	2 NOS	FOR LPBP LINE BLOWING
15	LR ELBOW 45 DEG 762X20	SA234WPC	6 NOS	PIPE FROM IV TO EXHAUST
16	TARGET PLATE ASSLY Ø 762	WELDMENT	2 NOS	FOR HRH LINE BLOWING
17	TARGET PLATES MIRROR FINISH Ø 762	SS	50 NOS	FOR HRH LINE BLOWING
18	PIPE Ø508X15.09	SA 106 GR B	100 m	LPBP TO EXHAUST
19	LR ELBOW 45 DEG 508X15.09	SA234WPC	6 Nos.	LPBP LINE BLOWING
20	FLAT END CLOSURE OD508 X35	SA 515 GR70	2 NOS	FOR HRH BLOWING
21	MATCHING PIECE P-92 TO P-22 508X15.09	MATCHING PIECE	2 NOS.	LPBP LINE BLOWING
22	MATCHING PIECE P-92 TO P-22 355.6 X 11.13	MATCHING PIECE	2 NOS.	HPBP U/S
23	QUICK OPENING MOTOR OPERATED VALVE NB 450	CLASS 1500	2 NOS	HPBP
24	ASME B 16.9 BW CON REDUCER DIA 559X16/ 457X19.05	SA 234 WPB	2 NOS	HPBP D/S
25	ASME B 16.9 BW CON REDUCER DIA 457X19.05/355.6 X 11.13	SA 234 WPB	2 NOS	HPBP U/S
26	PIPE Ø 323.9X10.31	SA 106 GR B	100 m	TDBFP BLOWING PIPE
27	ASME B16.9 BW LR 90DEG ELBOW Ø 323.9X10.31	SA 234 WPB	6 NOS	
28	TARGET PLATE ASSLY Ø 323.9	WELDMENT	2 NOS	
29	TARGET PLATES MIRROR FINISH DIA 168.3	SS	70 NOS	
30	HO GATE VALVES NB 50	CLASS 800	10 Nos.	DRAINS
31	HO GATE VALVES NB 25	CLASS 800	10 NOS	DRAINS
32	PIPE Ø 114.3 X 6.02	SA 106 GR B	80 m	SEAL STEAM BLOWING
33	PIPE Ø60.3X3.91	SA 106 GR B	100 m	DRAINS
34	PIPE Ø33.4X3.38	SA 106 GR B	100 m	
35	ISMB-200		50 m	SUPPORT MATERIAL
36	ISMC-200		50 m	
37	ISMB-150		50 m	
38	ISMC-150		50 m	
39	PIPE Ø 323.9 X 10.31	SA 106 GR B	100 m	TDBFP blowing pipe
40	ASME B16.9 BW LR 90DEG ELBOW Ø 323.9 X 9.52	SA 234 WPB	10 NOS.	
41	TARGET PLATE ASSEMBLY NB 300	WELDMENT	2 NOS.	
42	TARGET PLATE MIRROR FINISH NB 300	SS	50 NOS	

THE SCOPE OF THE WORK WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

11.0 GENERAL

11.1 The intent of this specification is to provide services for execution of project according to most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for the proper and efficient services towards installation of the plant shall not relieve the contractor of the responsibility of providing such services/ facilities to complete the work or portion of work awarded to him. The quoted/ accepted rates/ lump sum price shall deem to be inclusive of all such contingencies.

11.2 It is not the intent to specify herein all details of all 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.

11.3 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost

11.4 The contractor shall carry out the work in accordance with standard practices / codes / instructions / drawings / documents / specification/ manuals supplied by BHEL from time to time.

11.5 The work shall conform to dimensions and tolerances given in various drawings and documents that will be provided during execution. If any portion of work is found to be defective in workmanship, not conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be affected from contractor's bills towards expenditure incurred including BHEL's usual overhead charges.

11.6 Following shall be the responsibility of contractor and have to be provided within finally accepted rates/ prices:

- Provision as required of all types of labour, supervisors, engineers, watch and ward, tool & tackles, calibrated inspection, measuring and test equipment as specified and otherwise required for the work, consumables for erection, testing and commission including material handling.
- Proper out-turn as per BHEL’s plan and commitment

- Completion of work as per BHEL schedule
- Good quality and accurate workmanship for proper performances of equipment
- Repair and Rectification
- Preservation/ Re-conservation of all components during storage/ reaction till handing over

11.7 The quantities indicated in the tender specification are approximate and are liable for variation and alteration at the discretion of BHEL. The quoted unit rate shall be applicable for any additional product group also, if included at a later date integral to the main scope of work/ package envisaged. The work executed shall be measured and price as per the unit rate arrived at for each work area as mentioned in the relevant clauses.

11.8 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.

11.9 The contractor shall carryout additional tests if any, which the Engineer feels necessary because of site conditions and also to meet system specification.

11.10 The work shall be executed under the usual conditions without affecting power plant construction / operation 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.

11.11 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence.

11.12 Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.

11.13 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.

11.14 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor.

11.15 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.

11.16 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.

11.17 The terminal points as decided by BHEL shall be final and binding on the contractor.

11.18 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.

11.19 **HOUSE KEEPING:** The contractor is supposed to carryout housekeeping of the work area on regular basis to keep the work place neat and tidy and available for the SAFE working. The scrap, generated daily during the Execution activities, is to be dumped at designated area as decided by BHEL/ customer on daily basis. The erection materials issued to the contractor and kept near the work are should also be staged properly at site. Compliance report on above shall be submitted by the contractor to BHEL on Daily basis. In case the contractor fails to do so, BHEL have rights to carry out the same from the other party at Risk & Cost of the contractor. The cost applicable with BHEL overheads shall also be recovered from the monthly running bills of contractor.

THE SCOPE OF THE WORK WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

12.0 CIVIL WORKS, FOUNDATION, GROUTING

12.1 BHEL/ Customer shall provide all equipment foundations. For the correctness of these foundation as per drawings, the contractor shall check the dimensions & locations of the foundations, pockets, anchor-bolt pitch. Further, top elevation of foundations shall be checked with respect to benchmark. All minor adjustments of foundation level, dressing and chipping of foundation surfaces up to 50mm, enlarging the pockets in foundations, cleaning using compressed air, etc., as may be required for the erection of equipment/ plants shall be carried out by the contractor.

12.2 While on the job, care is essential to avoid too much chipping and resultant lowering of level. In case of excess chipping, contractor has to arrange additional packer plates as per requirements provided BHEL Engineer allows it. When required by manufacturers, the embedded sub-sole plates shall be scraped and checked with Prussian blue to get the required contact with frames. The required packer plates shall be provided by BHEL free of cost. Certain packer plates and shims over and above the quantity received as a part of supplies from manufacturing units of BHEL will have to be cut out from steel plates / steel sheets at site to meet site requirement. Contractor shall cut and prepare packers and shims by gas cutting / chiseling / grinding and de-burr the same. However, machining of the packers wherever necessary, shall be arranged by contractor.

12.3 Contractor shall ensure perfect matching of packer plates including machining, scraping and blue matching with foundation by dressing the foundation, as well as perfect matching between the packer plates and the base plate of equipment to the satisfaction of BHEL Engineer. If required the packer plates may have to be aligned and fixed on the foundations using special high strength, non-shrinking and quick setting grouts. The minimum thickness below the packer plate should be 20mm. The material required for this has to be arranged for by the contractor at his cost.

12.4 **Complete grouting of STG & Aux equipment as per the scope, including anchor/ foundation bolts, beneath base, base hollows etc as may be applicable, is EXCLUDED from the scope of contractor. The BHEL's Civil Contractor shall carryout and arrange for all materials required for carrying out the grouting including the supply of the Special Grout as indicated in the drawings and as approved by the BHEL Engineer.**

While grouting the contractor has to ensure that all the matching joints which are not to be grouted shall be kept free from the grouting mixture by applying tape or any other alternative method approved by Engineer. If required, decoupling of equipment's has to be done for conducting the verification. In case any disturbance is noticed the cause, if any, shall be removed and re-alignment done as part of work**. Contractor shall check and verify the alignment of equipment. The contractor has to ensure that all the matching joints which are not to be grouted shall be kept free from the grouting mixtures by applying tape or any other alternative method approved by Engineer. All assistance required has to be provided by the contractor**.

12.5 Contractor shall check and verify the alignment of equipment, alignment of shafts of rotating machines, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, coupling etc as applicable and the likes items to ensure that no displacement had taken place during post grouting check-up and verification. Such pre and post grout records of alignment details shall be maintained by the contractor in a matter acceptable to the Engineer.

The scope of the work will comprise of but not limited to the following:
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

13.1 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment, placement on respective foundation / location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipment from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks/ slings/ tools and tackles / labor including operators, fuel, lubricants etc. for Loading & unloading of materials will be in the scope of contractor.

13.2 The storage yard is located inside the Main Plant Boundary, in more than one location.

13.3 Some consignments like ODC consignments may be unloaded near to erection site as per space availability.

13.4 Loading at storage yard and transporting to site, unloading at site / pre assembly area or at working area, is in the scope of work. Required cranes for loading & unloading of materials, trailer shall be in the scope of contractor. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, sandbags which are required for temporary supporting of the components at site.

13.5 The equipment / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

13.6 Contractor shall plan and transport equipment, components from storage yard to erection site in such a manner and sequence that material accumulation at site does not lead to congestion at site of work.

13.7 Sometimes it may become necessary for the contractor to handle certain unrequited components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

13.8 Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept

at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

13.9 All pipe and tube ends shall be covered with plastic caps or will be closed with wooden plugs as the case may be.

13.10 The contractor shall take necessary measures to see that all the machined surfaces are preserved and covered.

13.11 The contractor shall take all such measures as may be reasonably necessary to ensure that its arrangements and those of its sub-contractors with respect to the transport of Goods, Materials and Labor to the site do not interfere with local traffic in the vicinity of the site and where such interference is unavoidable shall make such special arrangements as may be reasonably required to minimize the effect of such interference.

13.12 All lifting tackles including wire ropes, slings, shackles etc. used by the contractor shall be got approved by BHEL Engineer at site before they are actually put on the work. It will be the responsibility of the contractor to ensure safe lifting of the equipment taking due precautions to avoid any accidents and damage to other equipment and personnel. All piping shall be adequately supported and protected to prevent damage during handling and erection. The history cards for major equipment to be maintained by the contractor.

13.13 Sometimes it may become necessary for the contractor to handle certain unrequired components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

14.0 ERECTION

14.1 All normal erection and assembly techniques necessary for completion of works under this specification and magnitude have to be carried out. It is not possible to specifically list out of all of them. Absence of any specific reference will not absolve the contractor of his responsibility for the particular operation. These would include, Scaffolding and rigging operations,

a) Scaffolding and rigging operations,
b) Machine/ flame/ electric cutting, grinding, welding, radiography and stress relieving
c) Fitting, Fettling, Filing, Straightening, Chamfering, Chipping, Scrapping, Reaming as cleaning, checking, levelling, blue matching, aligning and assembly
d) Machining, Surface grinding, drilling, doweling, shaping
e) Temporary erections for alignment, dismantling of certain equipment for checking, cleaning, servicing and site fabrication
f) Insulation and painting

14.2 Any fixtures, scaffolding materials, approach ladder, concrete block supports, steel structures required for temporary supporting, pre-assembly or checking, welding, lifting and handling during pre-assembly and erection shall be arranged by contractor at his cost.

14.3 Contractor has to arrange required fire proof tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.

14.4 **Field Quality Assurance Formats:-** It is the responsibility of the contractor to collect and fill up the relevant FQA log sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL and customer as token of their acceptance. Payment to the contractor will be linked with the submission of these FQA log sheets.

14.5 All tests required as per **FQP** (**Field Quality Plan**) will be in Bidder's scope. FQP shall be provided during execution time.

14.6 No members of any ladder/ structure/ platform should be cut without specific approval of BHEL. In case it is necessary to cut, the contractor shall rectify/ repair in a manner acceptable to BHEL/ Customer without any additional cost.

14.7 Contractor shall erect scaffolding/ temporary platforms for erection. These should be of adequate capacity and shall never be over loaded. These should be replaced when not found suitable during erection work and dismantled on work completion and removed from such site.

14.8 It shall be the responsibility of the contractor to provide ladders on columns for initial work till such a time stairways are completed. For this, the ladder should not be welded on the column and should be pre-fabricated clamping type ladders. No temporary welding on any structural member is permitted except under special circumstances with the approval of BHEL. In case it is absolutely necessary then the contractor shall cut the temporary structure and rectify the column as directed by the engineer.

14.9 Contractor is strictly prohibited in using the Boiler/ Auxiliary Components for any temporary supporting or scaffolding works etc. In case of such misuse a sum of determined by Engineer will be recovered from the contractor's bills.

14.10 Corrections like straightening of ladders, tube support plates adjustment / removal of ovulates in pipes and opening or closing the fabricated bends of piping to suit the layout shall be considered part of the work and the contractor is required to carry out such work within finally accepted price / rate as per instructions of Engineer.

14.11 The contractor shall carry out assembly and erection of condenser components normally on the condenser foundation directly. This includes

- Assembly and welding of bottom plate, side plates, hot well, springs and steam throw device.
- Complete fabrication and welding of shell out of loose side-walls dome walls, and stand pipes.
- Assembly and welding of water chambers and water-boxes.
- Assembly and welding of support plates, baffles and stiffening structure,
- Tubes insertion, expansion and cutting/ trimming.
- Water Box Handling system
- The NDT requirement is to be met as per the FQP, Drawings. In addition to other NDT requirements, MPI of all field joints may be required to be carried out by the contractor for the condensers and auxiliaries.

Hydraulic test and water fill test and any other fitting/ assemblies required to complete the assembly. **Water fill test has to be carried out by filling the steam space with water**

up to 300 mm above the final joint of the condenser exhaust hood with turbine. It should be such as all field welding joints are covered in the test.

14.12 The contractor shall carry out the condenser tube insertion and expansion at site after the installation of condenser on its foundation. Condenser tubes shall be handled strictly as per instructions of BHEL Engineer. Before installation of tubes, the contractor shall check for any dents, mechanical damages or any other defects of tubes caused during storage. These should be thoroughly internally and externally cleaned for all extraneous matter as per the directions of the engineer.

14.13 Before insertion of tubes, the contractor shall clean the surface of the holes in the main tube plates and tube support plates for paint, corrosion spots oxide scale etc. as per the instructions of the engineer. R**eaming of support plates if required for smooth insertion of tubes is to be carried out by contractor at his cost and reaming and its arrangement is to be arranged by contractor.**

The contractor shall carry out the tube insertion & expansion of the condenser strictly in accordance with the instructions issued by the engineer. Tubes may require adjustment of length on both ends. The contractor shall ensure to provide covering above the top row of tubes to avoid any damage to the tubes prior to tube insertion as per instruction of BHEL Engineer at his cost. The equipment and consumables required for condenser tube cutting and expansion/flaring has to be arranged by the contractor, with no extra cost to BHEL.

Fluroscent dye test may be required to conduct after completion of tube expansion for detection of any leakages from the tubes. Contractor has to do all arrangement of filling of water to the condensers and then draining it as per customer Requirement. The supply of fluroscent dye (specification to be taken from BHEL Engineer) and the UV lamp for detection has to be arranged by contractor, with no extra cost to BHEL.

14.14 The contractor shall carry out the condenser neck welding with casing only after final installation of casing. However the contractor shall adjust the gap between condenser neck and LP exhaust hood uniformly by suitably lifting the condenser as directed by engineer. Also the makeup pieces required for this purpose shall be fabricated and welded to the dome walls by the contractor.

14.15 The feed water storage tank will be supplied in three sections with feed pipe, heating steam header, spray nozzles, supports etc., in loose components. These are to be erected, pre-assembled, aligned & welded in position. Welding, NDT & heat treatment if required shall be carried out by the contractor within quoted rate. IBR / statutory requirements, if

any, shall be in the scope of contractor and necessary drawing/ details only will be given by BHEL.

14.16 Erection of platform and supporting structures around FST / Deaerator is covered in the scope of contract and shall be erected by the contractor within the quoted rate of Rate schedule. Any platforms supplied by the Manufacturing Units/vendors with the equipment, auxiliaries has to be erected within the quoted rates.

14.17 LP Heater No. 1 is to be erected inside the condenser in rear side, for which contractor may require to cut open the condenser dome plate already erected. After erection, condenser plates have to be strengthened / stiffened as per the instruction of BHEL Engineer.

14.18 Some of the rotating equipment and electrical motors are provided with protective greases only. Contractor shall arrange for cleaning of the same with petrol or some other reagent. If necessary, dismantling some of the parts of the equipment would be necessary. He shall arrange for re-greasing / lubricating them with recommended lubricants and for assembling back the dismantled parts, at quoted rate. Lubricants will, however, be supplied free of cost by BHEL.

All rotating machines and equipment shall be cleaned, lubricated, checked for their smooth rotation, if necessary by dismantling and refitting before erection. If, in the opinion of Engineer, the equipment is to be checked for clearance, tolerance at any stage of work or during commissioning period, all such works are to be carried out by contractor at his cost.

14.19 The turbine Integral Piping and Overload piping of Turbine are of SA335P91 material specification. The erection, welding, heat treatment, NDT, H&S of these are in scope of this contract only. The contractor has to arrange for the IBR requirements. **Also, the consumables such as electrodes and filler wire, thermocouple, ceramic pads and insulation, induction coil etc. for SA335P91 welding has to be arranged by the contractor only**. **The contractor has also to arrange for spot welding of the thermocouples.** BHEL will only provide induction heating Machine and DG set with recorder.

For other integral piping of this contract scope of Haridwar and Hyderabad scope, all the consumables have to be supplied by contractor at no extra cost. BHEL may only supply any consumables which are supplied by the MU's and vendors as part of the package. **BHEL will NOT supply any electrode / filler for P91/T91 as per clause no. 4.1.4 of chapter IV (Obligation of Contractor) of of SCC (TG PACKAGE) of this contract**.

All the welding consumable such as electrodes/filler wires to be used in welding has to be of BHEL approved brand. Before procuring contractor shall ensure the same with BHEL.

14.20 All the shafts of rotating equipment shall be properly aligned to those of the matching equipment within design tolerances. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

14.21 All the motors and equipment shall be suitably doweled after alignment of shafts with taper / parallel machined dowels as per the direction of the Engineer. Dowel pins required are be machined by the contractor at his own cost. However the materials for dowel pins shall be issued by BHEL free of cost.

14.22 The bearings shells will be blue matched at site and checked for bearing clearances. The contractor shall carry out scraping of bearing housing, if required to any extent. No extra claim for blue matching of any two surfaces up to 1mm initial gap will be entertained. The contractor shall also check air gap and adjustment of stator/ rotor to magnetic center shall be carried out as part of erection.

14.23 Contractor shall carry out trial run of all motors including checking the direction of rotation in the uncoupled condition. Checking of alignment and re-coupling of the motor to the driven equipment as per instructions of BHEL engineer and to their satisfaction.

14.24 Contractor shall fabricate pipe, special bends etc, threading and welding as required for installing lube oil system and carry out the acid cleaning of fabricated piping. The contractor shall also service the lube oil system, carrying out the hydraulic test of oil coolers etc.

14.25 All electrical panels, control gears, motors and such other devices shall be properly dried by heating to improve IR valve before they are energized. Bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected.

14.26 The contractor shall completely erect and test all piping systems, covered in the specification including sampling lines up to and including sample coolers, hangers & supports, valves and accessories in accordance with the drawings furnished. This includes all necessary bolting, welding, pre-heating, stress relieving, testing, cleaning and painting. System shall be demonstrated in condition to operate continuously in a manner acceptable to the Engineer. Welding shall be used throughout for joining pipes except where flanged, screwed or other type joints are specified or sown on the drawings. All piping shall be erected true to the lines and elevation as indicated in the drawings.

14.27 Most of the pipes shall be supplied un-fabricated in running lengths without beveling. It shall be responsibility of contractor to carry out fabrication by cutting to size, bevel / prepare edges, fabricate support pads, drill holes for drains, vents and other stubs, welding, carryout NDT & SR as per site requirement & as directed by BHEL. Pipes sent in standard length shall be cut to suit the site conditions and the layouts. Tubes or pipes wherever deemed to be convenient will be sent in running lengths with sufficient bends. Bends upto 80 mm Nb will be fabricated at site wherever required.

14.28 The connection to the pipes terminal points including edge preparation, fit-up, welding applicable NDE etc are in the scope of work. Certain adjustments in length may be necessary while erecting pipelines. The contractor should remove the extra lengths/add extra lengths to suit the final layout after preparing edges afresh at no extra cost. Minor adjustment like removal of ovality in pipes is in the scope of work. All drains / vents / relief tubes / escape pipes / air relief valves/ safety valve/ piping to various tanks / sewage / drain canal / flash box / sump / atmosphere etc. from the piping and equipment erected by the contractor is completely covered in the scope of work.

14.29 Certain adjustments in length may be necessary while erecting pipelines/ducts/ casings etc. The contractor should remove the extra lengths/add extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures at no extra cost, wherever indicated.

14.30 It is possible that a few flanges may not be matching. The contractor shall be required to cut and re-weld the same as and when required without any additional cost.

14.31 The contractor shall be responsible for any modifications of shop fabricated pipes prior to installation to accommodate minor site alteration in pipe routing at no extra cost.

14.32 All vents and drains for piping equipment covered in the scope whether shown in the drawings or not, shall be terminated outside the TG hall in atmosphere and at sump-pit as directed by the engineer.

14.33 Wherever equipment/piping erected by the contractor is connected to equipment/ piping erected by the other agencies the joint at the connecting point shall be the responsibility of the contractor of this specification.

The erection, welding (Both joints) and NDT of all Metallic Expansion Joints, Butterfly valves of drive turbine exhaust system shall be the responsibility of the contractor of this specification only.

14.34 Normally the high-pressure valves will have prepared edges for welding. But, if it becomes necessary, the contractor will prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes. All fittings like `T' pieces, weld neck flanges, reducers etc., shall be suitably matched with pipes/valves for welding.

14.35 The valves will have to be checked, cleaned or overhauled (including lapping of seat) in full or in part before erection and/or after chemical cleaning and during commissioning.

14.36 The contractor shall be responsible for correct orientation of all valves so that seats, stems & hand wheels are in desired direction. It is the responsibility of the contractor to obtain the information regarding orientation of valves not fully located on drawings before the same are installed.

14.37 Steel for suspensions for piping, will be supplied in running lengths. These are to be cut to suitable sizes and adjusted as per requirement.

14.38 No temporary supports should be welded on the piping. In case of absolute necessity prior approval should be taken from BHEL Engineer. In such cases heat treatment, if required, shall be carried out by the contractor

14.39 All hangers, supports and anchors shall be installed as per drawing to obtain safe and reliable and complete pipe installation as per instructions of Engineer. Any additional support as called for by Engineer shall have to be fabricated and erected by the contractor. The raw materials required for fabricating such supports shall be supplied by BHEL free of cost.

14.40 Spring suspensions/ constant load hangers may have to be pre-assembled for required load and erection carried out as per instructions of BHEL. Any adjustments, removal of temporary arrestors / lockers etc., have to be carried out as and when required.

14.41 Contractor shall install piping in such a way that no excessive or destructive expansion forces exist either in the cold condition or under conditions of maximum temperature and pressure. All bends, expansion joints and any other special fittings necessary to take care of proper expansion shall be incorporated as per the advice of Engineer. During installation of expansion joints, anchors, care must be taken to see that full design movement is available at all times from maximum and minimum temperature.

14.42 The contractor shall carry out the tightening of the field bolts on the equipment and piping covered under this specification by using either the calibrated torque wrench method or the turn of part method. The procedure to be followed, the tools and the equipment

deployed shall be subject to the approval of Engineer. All the torque wrenches shall be calibrated as per requirement and before they are put in use on any job.

14.43 The contractor shall ensure that all supporting elements, anchors & restraint have been installed and adjusted in accordance with the drawings / sketches & other written instructions of the Engineer. The contractor shall inspect the hangers associated with the piping systems as follows:

- After hydraulic test, with the piping in the cold position, with all travel stops removed, with the pipe completely insulated and complete in all respect ready for start up.
- Piping in the hot position with the unit operating at the maximum load.
- Piping in the cold position during the first complete shutdown.

14.44 The hanger assemblies shall not be used for attachment of rigging to hoist the pipes into position. Separate temporary supports shall be used to securely hold the pipe in position till pipe supports are completely assembled and attached to the building structure.

14.45 Layout of small bore piping as required shall be done as per site requirement. Necessary sketch for routing these lines should be got approved from BHEL by the contractor. There is a possibility of slight change in routing the above pipelines even after completion of erection or from aesthetic point of view. Contractor at no extra cost should carry this out.

14.46 Erection, testing and commissioning of power cylinders, electrically operated valves and their actuators etc. coming under various groups is covered under the scope of this specification.

14.47 All valves, including valves, flap valves, dampers and actuators, shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and during pre-commissioning also. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work within the quoted rates.

14.48 The contractor shall also or grind the valve seat, if required, to ensure satisfactory performance of valves at no extra cost. All parts such as gaskets, gland packing which form the permanent part of equipment shall be supplied by BHEL free of cost.

14.49 Erection and welding of necessary instrumentation tapping points, thermocouple pads, thermo-wells, valves, battery of first root valves, condensing vessels, flow nozzles and control valves to be provided on TG, auxiliaries and pipe lines covered within the scope of this specification, will also be the responsibility of the contractor. The welding of all the above items will be contractor's responsibility even if the:

- Product groups, under which these items are released, are not covered in the scope of this tender.

- Items are supplied by any agency other than BHEL.

NOTE: ADDITIONAL THERMOWELLS AS REQUIRED FOR CONDUCTANCE OF THE PERFORMANCE GUARANTEE TEST ARE TO BE INSTALLED BY THE CONTRACTOR.

14.50 Erection of CO_2, N_2 and H_2 systems complete in all respects, including cylinders stands, connecting piping, valves, distribution headers, main control panels etc. is in the scope of contractor. The delivery of gas cylinders is to be taken from BHEL / its client stores, their handling and filling of gases in the system as and when required, till unit is commissioned and handed over, shall be the responsibility of the contractor. The empty cylinders are to be returned to BHEL/its client stores. Filling / Refilling of CO_2, N_2 and H_2 cylinders shall be in the scope of BHEL but handling & filling of gases from yard/store/filling station and into the system shall be in the scope of contractor. After commissioning of Hydrogen plant located along the boundary of Powerplant the handling/filling/refilling of H_2 Cylinders shall be in the scope of contractor.

14.51 Additional platforms and ladders of permanent nature incidental to the job for approaching different equipment / valves as per site requirement, which may not be indicated in drawings, shall be fabricated and installed by the contractor. The materials required will be supplied by BHEL free of cost. The lump sum price quoted is inclusive of this price.

14.52 The contractor shall carry out Kerosene oil / dye penetration tests of all the bearing housing of turbine & generator. The Kerosene oil DPT kit for the tests shall also be arranged by the contractor at his cost.

14.53 The contractor is strictly prohibited in using the TG / Aux. Components for any temporary supporting or scaffolding woks etc. In case of such misuse a sum of determined by Engineer will be recovered from contractor's bills.

14.54 The calibration of skid mounted instruments shall be arranged by BHEL through other agency engaged for C&I. Contractor will be informed by BHEL engineer about the details of C&I agency. The contractor shall coordinate with the C&I agency for removal, calibration and re-installation of the instruments. Though C&I agency may remove and reinstall the instruments after calibration, the contractor for this package will maintain the list of all the instruments removed & reinstalled. Instruments prior to removal and after reinstallation shall be considered in custody of the contractor for this package.

14.55 For all other instrumentation, erection up to root valves (single/double), thermo-wells is the responsibility of this contractor.

14.56 The feed storage tank will be received in 3 pieces and is to be assembled, welded and tested at site. Besides the provisions under T&P Clause, all other arrangements for erection of feed storage tank and deaerator has to be made by contractor with in their finally accepted price.

14.57 The contractor shall assist BHEL in preparation of as built piping drawing.

14.58 Assistance in mechanical work associated with power cylinders, valves, valve actuators, etc, coming under various groups shall be provided by contractor within the finally accepted rates.

14.59 Whenever required the contractor shall arrange for pre-qualification of process task performers.

14.60 Non specified jobs at the interface/ terminal points like bolting welding, gasket changing etc have to be done by the contractor within the quoted price.

14.61 Instrument tapping coming wherever to be welded/ fitted by the contractor within the quoted price.

14.62 The terminal points decided by BHEL should be final and binding on the contractor for deciding the scope of work and effecting payment for the work done.

14.63 Instrumentation like pressure switches, air sets, filters, regulators, pressure gauges, dial thermometers, flow meters, valve actuators, flow indicators, centrifugal/ speed switches of motors etc which are received in assembled condition as integral part of equipment shall be dismounted, calibrated and re-erected by the contractor as per requirement.

14.64 The contractor, at no extra cost to BHEL, shall carry out servicing and realignment of skid-mounted equipment.

14.65 Certain instruments like pressure gauges, pressure transmitters, temperature gauges, flow switches and indicators, etc .are received in assembled condition as integral part of equipment. Contractor shall be responsible for safe receipt, installation and custody of these instruments supplied mounted on skids/ equipment. The calibration of skid/ equipment mounted instruments shall be arranged by BHEL through other agency engaged for C&I. Contractor will be informed by BHEL engineer about details of C&I agency. The contractor shall coordinate with the C&I agency for removal, calibration and re-installation of the instruments. Though C&I agency will remove and reinstall the instruments after calibration, the contractor for this package will maintain the list of all instruments removed and reinstalled. Instruments prior to removal and after

reinstallation shall be considered in custody of the contractor for this package. All instruments such as pressure gauges/ temperature gauges, switches etc forming part of product group (PG) are under the erection scope of this contract and shall be installed and commissioned by the contractor of this package at no extra cost to BHEL. However, the calibration of these instruments shall be done by C&I agency as above.

14.66 Pipes sent in standard length shall be cut to suit up the site conditions and the layouts. Tubes and pipes wherever deemed to be convenient will be sent in running lengths with sufficient bends. Bends upto 65mm nominal bore will have to be fabricated at site. Only cold cutting methods are to be employed for cutting piped and tubes irrespective of the size and material. Gas cutting, if any, will be allowed only in CS LP piping.

14.67 Wherever piping erected by the contractor is connected to equipment/ piping erected by the other agencies the joint at the connecting point shall be the responsibility of the contractor who is erecting the piping under this specifications.

14.68 Normally, the high pressure valves will have prepared edges for welding. But, if it becomes necessary, the contractor will prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes within the scope of work.

14.69 All fittings like `T'-pieces, weld neck flanges, reducers etc., shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection after chemical cleaning and during commissioning.

14.70 Contractor shall be responsible for correct orientation of all valves so that seats, stems and hand wheels will be in the desired location. It is the responsibility of the contractor to obtain the information regarding orientation of valves not fully located on the drawings before the same are installed.

14.71 All the valves, including motorized valves, flap valves, dampers, actuators, etc shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and during pre-commissioning also. Welding or jointing shall be part of erection work within the quoted rates.

14.72 Erection, testing and commissioning of all electrically operated valves, actuators and dampers is covered within the scope of this specification.

14.73 Welding of P91, T91, and T92 materials is to be carried out as mentioned in **clause no 15.38** of TCC.

14.74 Scope of work for chemical cleaning for the system has been covered under **clause no 15.39** of TCC.

14.75 All the equipment / material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect. The contractor shall clean, wherever necessary and paint inside surfaces of the equipment like coolers, oil tanks, and other components as per instruction of BHEL Engineer during erection at the quoted rate. The necessary compressor for air cleaning is to be arranged by contractor at his cost.

14.76 During hydro test, pipe end dummy if required shall be supplied by BHEL, plates shall be cut for the requirement and shall be returned back to BHEL Stores.

14.77 Arrangements for providing required dewatering (in the area covered in this contract scope) during erection, by suitable dewatering pumps / Continuous Multi Point Dewatering etc , as per site requirement is included in the scope of work . Vendor has to arrange adequate no. of Diesel & electrical pumps suitable capacities ,diesel ,operators, necessary manpower with sufficient quantity of suction & discharges hoses, pipes, Clamps, cables, Electrical panels/starters, consumables without any extra commercial implication on BHEL treating as normal scope of work.

14.78 **CONCRETE ENCASED CW PIPING**

i. The pipe in general shall be laid on the bottom cement encasing and welded. After Hydro test clearance will be given for top end casing of CW piping.
ii. The scope, quantity & sizes of buried piping are as per BOM and the relevant drawings.
iii. The civil works for the buried piping are excluded for this scope of work. However the contractor has to ensure that the width of the trench shall be sufficient to give free working space on each side of the pipe.
iv. Access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained. This type of incidental works are to be carried out by the contractor within quoted rates.
v. Prior to lowering and laying pipe in any trench, the contractor shall check & ensure for the backfilling and compaction the bottom of the trench or excavation in accordance with IS 5822 / as per drawing to provide an acceptable bed for placing the pipe. Necessary co-ordination with the BHEL's civil agency shall be carried out by the contractor for the same.

14.79 The entire civil work of CW Piping is excluded from the scope of contractor however the required dewatering well point dewatering to be carried out before and during erection of CW piping.

14.80 Contractor shall erect CW pipe line as per the sequence prescribed by BHEL at site. The sequence of erection and methodology will be decided by the BHEL Engineer depending upon the availability of materials, fronts and other inputs etc. No claim for extra payment from contractor will be entertained on the grounds of deviation from the methods of erection adopted in erection of similar piping in other places.

14.81 The CW piping materials shall be supplied as per specification below:

a) Piping 200NB and above shall be carbon steel rolled & welded as per IS : 3589 from CS plates (IS : 2062), internally lined with corracoat/ polyurea coating inside of 2000micron DFT
b) All pipes above 50 NB shall be supplied with edge preparation.

14.82 The contractor may have to carry out fabrication of mitre bends, tees, reducer of sizes NB 250 and above for CW piping systems. Pipes will be supplied in running meters by BHEL free cost. Required number of mitre bends, tees is to be fabricated by the erection contractor without any extra claim.

14.83 Terminal point of CW piping is around 15m outside from center line of A-row axis.

14.84 Carrying out piping as per the specification between equipment constituting terminal points, whether the terminal equipment fall within the scope of work/specification, contractor shall carry out the terminal joints at either end. Also where the piping connection to the terminal points involve flanged joints, matching of flanges, fixing gaskets, bolting and tightening as per BHEL Engineers instructions is in the scope of work. In case piping connected to equipment, matching of flanges for achieving the parallelism and alignment at the equipment end, by suitably resorting to heat correction or other method as instructed by BHEL Engineer, with in the quoted rate.

14.85 Contractor has to draw the material either from BHEL store yard or fabrication yard and transport to his working place.

14.86 For CW Pipes Welders shall be qualified as per the welder qualification procedures of BHEL/ASME, applicable for this type of job. Only qualified welder shall be deployed for welding.

14.87 All dimensions / elevations refer to centerline of CW pipe unless otherwise specified and the pipe routing shall be carried out as per the drawing. Wherever the dimensions are not specified / shown as approximate the same may be routed as per site requirement / convenience as per site engineer's advice.

14.88 Normally weld neck valves will have prepared edges for welding. It may be occasionally necessary to prepare new edges, re-prepare the edges to suit site conditions, which shall be done by the contractor at no extra cost.

14.89 Contractor shall arrange all the equipment, alignment bolts, tools, consumables like welding rods, etc. for welding of pipes and consumables like jute, cotton waste, hacksaw blades, petrol, Kerosene oil etc. are also in contractor's scope. All these shall be carried out with in the quoted rate.

14.90 Contractor shall use only bolted clamps for achieving alignment of piping, wherever "L" shaped stoppers and wedges are to be used for aligning piping and equipment, the same shall be subjected to the approval of BHEL Engineer. Contractor shall remove the bridge, stopper etc., and not by hammer. Any burrs left on the equipment / piping, after welding, shall be ground off or any scar or cavity made good by welding and grinding. NDT tests shall be carried out if necessary to detect surface and subsurface cracks in these ground areas.

14.91 All the weld joints on equipment and piping shall be ground or filed on completion of welding as per instructions of BHEL Engineer so as to achieve smooth surface devoid of ripples, undulations etc.,

14.92 Pipelines shall be cleaned off welding slag and burrs by hand files, wire brushes and flexible grinders wherever required.

14.93 Temporary lugs / structures meant for transportation is to be removed by the contractor as and when instructed by BHEL Engineer.

14.94 Flame cutting of piping and other equipment shall be strictly done as per BHEL Engineer's instructions and in his presence only.

14.95 Contractor shall also weld small length of piping with root valve to the pressure, flow and level tapping points on piping or flow nozzles / orifices / metering elements fixed on piping as per the instructions of BHEL Engineer.

14.96 On completion of bottom layer of pipes, contractor has to conduct hydraulic test. For conducting hydro – test both ends of each lines are to be blanked suitably. Raw materials for blanking such as plate / structural items will be given by BHEL on free of charges. Fabrication, welding of dummies and NDT and removal of dummies after successful completion of hydro – test and making edge preparation on the parent pipe after HT is in the scope of contract. For Hydro test to be conducted in stages or to be repeated, the same plates shall be used for blanking by suitably grinding.

14.97 Contractor shall arrange all temporary piping, pumps, etc required for the hydraulic test, pressure gauges etc. Required pipes, valves, etc., are to be brought /arranged by contractor. Temporary piping, pumps, valves, flanges, blanks etc shall be removed by him once the work is over and could be taken back. The pipes, fittings, valves, etc shall be suitable and withstand the rated hydro test pressure. The pump shall be suitable for pressurization to this test pressure and the volume of water to be used for sectionalized hydro test.

14.98 The contractor has to arrange (low pressure) hydro-testing pump for conducting hydraulic test on his own with in the quoted rate. The servicing, installation, electrical connection, erection, testing and dismantling after completion of hydrotest shall be carried out by the contractor as part of this work without any extra charge. The pump would be taken back after completion of the work as certified by BHEL engineer.

14.99 Required water filling pump is to be arranged by the contractor.

14.100 After completion of hydro test on bottom layer it is to be cleared for Civil agency, after de-watering and removing all temporary supports / scraps.

14.101 The BHEL supplied valves as part of CW system will have to be checked, lapped or serviced if required before / after erection. Contractor shall arrange experienced valve technician at his own cost. Any special tools required for lapping only will be arranged by BHEL.

14.102 All drains / vents/ relief line etc. from the stubs on the piping to be erected by the contractor, is completely covered in the scope of work.

14.103 The contractor shall conduct nondestructive tests like radiography ultrasonic test for weld defects etc., dye penetrant tests, magnetic particle test etc. on weld joints, castings, valve bodies and other equipment etc. as per BHEL Engineer's instructions / welding schedule.

14.104 The contractor shall arrange sufficient quantity of higher capacity pumps with all its accessories within the quoted rate to evacuate the percolating water from the CW trench during erection of piping systems. The water shall be discharged at a location identified by BHEL engineer.

14.105 Erection welding schedule shall be furnished during erection. 10 % Radiographic test shall be done.

14.106 Complete erection & commissioning of Firefighting system & Foam system equipment listed in contract is in the scope of contractor.

14.107 Complete erection & commissioning of Water system & Workshop equipment listed in contract is in the scope of contractor.

14.108 **Statutory Approval**

It shall be the responsibility of the Contractor to obtain the all necessary approvals/permits from the inspection/regulatory/statutory authorities etc. on behalf of the Employer, as may be required for design/calculations, manufacturing and erection procedure, testing etc. As called for under the statutes, regulations and the safety codes. All such documentation required to be submitted to the statutory authorities shall be submitted to the Employer for its review. **Cost of Approval & Inspection fee, if any, to be borne by Contractor without any extra cost to BHEL.**

15.0 **WELDING, HEAT TREATMENT, RADIOGRAPHY AND NDT**
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

15.1 The equipment and piping shall be erected in conformity with the provisions of Indian Boiler Regulations and as may be directed, as per other standard / specification in practice in BHEL. The method of welding (viz) ARC, TIG or other methods as indicated in the detailed drawing or as instructed by BHEL Engineer shall be followed. BHEL Engineer will have the option to change the method to suit site conditions and requirement.

15.2 Welding of equipment, piping, high tensile structural steel, piping shall be done by certified high pressure welders who possess valid certificate of CIB of the State in which equipment is erected as per the provision of IBR. The HP welder who possesses necessary certificate shall ensure re-validation as per relevant provision of IBR and keep the certificate valid till the completion of work. The services of such welders, the validity of whose certificate have expired shall not be utilized for high pressure works.

15.3 All welders including tack welders, structural and high pressure welder shall be tested as per ASME section IX / IBR and approved by BHEL Engineer before they are actually engaged on work even though they may possess a valid IBR certificate. BHEL reserves the right to reject any welder if the welder's performance is not found to be satisfactory. The contractor shall maintain the records of qualification of welders. BHEL Engineer will issue all the welders qualified for the work, an identity card. The welder will keep the same with him at work place at all times. He may be stopped from work if he is not found in possession of the same.

15.4 Engineer may stop any welder from the work if his performance is unsatisfactory for any reason or if there is a high percentage of rejection in the joints welded by him. The welder having passed qualification tests does not absolve the contractor of contractual obligation to continuously check the welder's performance.

15.5 Faulty welds caused by the poor workmanship shall be cut and re-welded at the contractor’s expense. The Engineer, prior to any repair being made, shall approve the procedure for the repair of defective welds. After the repair has been carried out, the compliance shall be submitted to the engineer.

15.6 The contractor shall carry out the root run welding of all HP / LP piping, valves by TIG welding method only. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required. During the root runs of stainless steel joints, the contractor shall before and during welding have to purge the pipes with inert

gas. All arrangements required for the above shall be the responsibility of the contractor at no additional cost.

15.7 All expenses for testing of contractor's welders including destructive and nondestructive tests conducted by BHEL at site or at laboratory shall have to be borne by the contractor only. Limited quantity of raw material required for making test pieces will be supplied by BHEL free of cost.

15.8 The regulators used on welding machines shall be calibrated before putting these into use for work. The Contractor at his cost shall also arrange periodic calibration for the same.

15.9 **Only BHEL/ CUSTOMER approved electrodes and filler wire are to be arranged and used by the contractor, within the finally quoted price. BHEL/ CUSTOMER reserve the right to test from the certified lab of approved electrode being used by the contractor.** Testing charges for the same shall be borne by the contractor. All electrodes shall be baked and dried in the electric electrode-drying oven to the required temperature for the period specified by the Engineer before these are used in erection work. All welders shall have electrodes drying portable oven at the work spot. The electrodes brought to the site will have valid manufacturing test certificate. The test certificate should have a co-relation with the lot number/ batch number given on electrode packets. No electrodes will be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from Govt. approved/ accredited test house traceable to National/ International standards will be submitted to BHEL before putting the oven in use. The contractor shall also arrange periodical calibration for the same.

15.10 All butt / fillet welds shall be subject to dye penetration test as per the instructions of the engineer at no additional cost. **10% RT will be applicable to all the circuits however applicable percentage of RT shall be guided by the field welding schedule.**

15.11 The contractor shall maintain a record in the form as prescribed by BHEL of all operations carried out on each weld. He has to maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required. Interpretation of the BHEL Engineer regarding acceptability or other wise of the welds shall be final.

15.12 The contractor shall carry out the edge preparation of weld joints at site in accordance with the details acceptable to BHEL Engineer. Wherever possible machining or automatic flame cutting should be done. Gas cutting will be allowed only wherever edge preparation otherwise is impractical. All slag / burrs shall be removed from the edge and all the hand cuts shall be ground smooth to the satisfaction of engineer.

15.13 All welds shall be painted with anticorrosive red oxide paint once radiography and stress reliving works are over. Necessary consumables and scaffolding etc including paints shall be provided by contractor at his own cost.

15.14 Pre-heating, radiography, UT and other NDT tests, post heating and stress relieving after welding of tubes, pipes, including attachment welding wherever necessary, are part of erection work and shall be carried out by the contractor in accordance with the instructions of the Engineer. Contractor at his cost shall arrange all equipment and consumables essential for carrying out the above process.

15.15 Contractor shall arrange all necessary stress relieving equipment with automatic recording devices. The contractor arrange for labour, heating elements, thermocouples, thermo-chalks, temperature recorders, thermocouple attachment units, graphs, sheets insulating materials like asbestos cloth, ceramic beads, asbestos ropes etc. required for heat treatment/ stress relieving operations. The contractor should take a note of the following,

- Temperature shall be measured by thermocouple and recorded on a continuous printing type recorder. All the recorded graphs for heat treatment works shall be the property of BHEL.
- All stress relieving equipment will be used after due calibration and submission of test certificate to BHEL. Periodic calibration from Govt. Approved / accredited Test Houses traceable to National / International standards will also be arranged by the contractor for such equipment at his cost.

The contractor shall obtain the signature of Engineer or his representative on the strip chart of the recorder prior to the starting of SR operations.

15.16 The contractor shall also be equipped for carrying out other NDT like LPI / MPI/UT / Hardness test etc. as required as per welding schedules / drawings within the finally accepted price / rates. For UT machine shall be used of recordable type.

15.17 The technical particulars, specification and other general details for radiography work shall be in accordance with ASME, IBR or ISO as specified by BHEL.

15.18 Contractor for radiography work shall use Iridium-192/Cobalt-60. The geometric un-sharpness shall not exceed 1.5 mm. The contractor should take adequate safety precautions while carrying out radiography. Contractor at his cost shall arrange necessary safe guards required for radiography (including personnel from BARC).

15.19 Low speed high contrasts, fine grain films (D-7 or equivalent) in 10 cm width only be used for weld joint radiography. Film density shall be between 1.5 to 2.0.

15.20 All radiographs shall be free from mechanical, chemical or process marks, to the extent they should not confuse the radiographic image and defect finding. Penetrometer as per ASME or ISO must be used for each exposure.

15.21 Lead numbers and letters are to be used (generally 6mm size) for identification of radiographs. Contract number, joint identification, source used, welder's identification and SFD are to be noted down on paper cover of radiograph.

15.22 Lead intensifying screens for front and back of the film should be used as per the above-referred ASME specification.

15.23 The joint is to be marked with permanent mark A, B, C to identify the segments. For this a low stress stamp shall be used to stamp the pipe on the down streamside of the weld.

15.24 For multiple exposures on pipes, an overlap of about 25-mm of film should be provided.

15.25 Radiography personnel with sufficient experience and certified by M/s BARC for conducting radiographic tests in accordance with safety rules laid down by Division of Radiological protection only have to be deployed. These personnel should also be registered with DRP / BARC for film badge service.

15.26 All arrangements for carrying out radiography work including dark room and air conditioner and other accessories shall be provided by contractor within the space allotted for office at his cost. As an alternative the contractor may deploy an agency having all above facilities and who are duly approved / accredited by BARC and / or other Regulatory authorities. Detailed particulars of such agencies will be submitted and got approved by BHEL Engineer before the actual deployment of agency for radiography work.

15.27 The contractor shall have a dark room fully equipped with radiography equipment, film (un-exposed), chemicals and any other dark room accessories.

Radiography inspection of welds shall be performed in accordance with requirement and recommendation of BHEL Engineer. The quantum of radiographic inspection shall be as per provision of ASME / BHEL/NTPC approved documents. However, minimum percentage of joints to be radiographed shall not be less than the requirement of BHEL welding schedule / IBR / Customer’s requirements. The percentage may be increased depending upon the quality of joints and at the discretion of BHEL.

Radiography on LP piping joints is not envisaged. However, other NDT test as called for in the FQP including LPI, MPI and HT will have to be carried out. Since, radioisotopes are being used, all precautions and safety rules as prescribed by BHEL/BARC/ Customer shall be strictly followed. BARC / DRP certificate to be provided before taking up the work.

15.28 The percentage of Radiography are tentative, which may be increased depending upon the quality of joints at the discretion of BHEL.

15.29 All the Radiographs shall be properly preserved and shall become the property of BHEL. They are to be reconciled with the work done, joints radio graphed and submitted to BHEL / customer.

15.30 Radiography of joints shall be so planned after welding that the same is done either on the same day or next day of the welding to assess the performance of HP welders. If the performance of welder is unsatisfactory, he is to be replaced immediately.

15.31 Wherever radiographs are not accepted, on account of bad shot, joints shall be re-radiographed and re- submitted for evaluation.

15.32 However, if the defect persists after first repair, further repair work followed with radiography shall be repeated till the joint is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radiographed at contractor's cost.

15.33 If the contractor does not carry out radiography work due to non-availability of source / film / chemical / operator etc., BHEL will get the work done departmentally or through some other agency at the risk and cost of the contractor.

15.34 Heat treatment and radiography may be required to be carried out at any time (day and night) to ensure the continuity of progress. The contractor shall make all necessary arrangements including labour, supervisors/ Engineer required for the work as per directions of BHEL.

15.35 The contractor shall assist BHEL Engineer in preparing complete field welding schedule for all the field welding activities to be carried out in respect of piping and equipment erected by him involving high pressure welding at least 30 days prior to the scheduled start of erection work at site. The contractor shall strictly adhere to such schedules.

15.36 The equipment and piping shall be erected in conformity with the provisions of Indian Boiler Regulation and as may be directed by BHEL as per any standard / specification in practice in BHEL. The method of welding (arc, gas, TIG or other method) may be indicated

in the detailed drawings / schedules. BHEL Engineer will have the option of changing the method of welding as per site requirements.

15.37 Check slots as per requirement BHEL/ Customer will be taken at contractor's cost.

15.38 **Erection Welding Practice for Materials P91/P92**

Special care is essential for carrying out the installation of this system and strict quality norms and welding procedure will have to be followed at site. The Contractor is advised to get familiarized with the work procedure. In addition to the general clauses for Welding, RT and NDT given under clause 15.0 of this tender, the following clauses will be applicable. This welding is to be carried out strictly under the supervision of BHEL Engineer and all repairs etc will be carried out as per the laid out procedure.

Some of the salient details in regards to T91/P91 material are being indicated in the clauses mentioned below however the erection, welding and NDT process are to be done as per the procedure /specifications to be furnished by BHEL / as per the instructions by site engineer.

- Prior to erection, supplied pipes shall be inspected thoroughly and if any defect like crack, lamination, and deposit noticed, the same shall be confirmed by Liquid Penetrant Inspection (LPI). If confirmed, it shall be referred to BHEL.
- Cutting of T-91/P91 material shall be done by bandsaw / hacksaw /machining / grinding only.
- Edge preparation shall be done only by machining/ by chamfering machine. In extreme cases, edge can be prepared by grinding with prior approval of BHEL.
- During edge preparation care should be taken to avoid excessive pressure to prevent heating up of the pipe edges.
- All edge preparation done at site shall be checked by Liquid Penetration Test. Weld built-up on edge preparation is prohibited.
- The pipe fit-up for welds shall be carried out properly, as per drawing specifications, by using temporary pipe clamps arranged by the contractor to ensure proper alignment and root gap. Use of site manufactured clamps for fit-up is acceptable. Neither tack welds nor bridge piece shall be used to secure alignment. Partial root weld of minimum 20mm length by GTAW may be allowed with the prior permission of BHEL engineers.
- Suitable reference punch marks shall be made on both the pipes (at about 200 mm from the EP) at least on four axis to facilitate UT on weld joint.
- Provide Enclosure for Welding area suitable for guarding against cold draught, water and dust at all welding locations.

- No pre-heating is required for fixing Thermocouples (of Ni-Cr / Ni – Al of 0.5 mm gauge size) with resistance spot welding.
- Argon gas to be used both for purging as well as shielding shall be of 99.99 purity levels conforming to IS 5760-1998. Dry Argon gas with requisite quality shall be used for purging the root side of weld. The gas flow rate to be maintained during purging is 10 to 25 liters / minute and for shielding during GTAW is 8 to 14 liters / minute
- The purging dam (blank) shall be fixed on either side of the weld bevel prior to Pre-heating. The dam shall be fixed inside the pipe and it shall be located away from the heating zone. Purging is to be done for root welding (GTAW) followed by two filler passes of SMAW in case of butt welds.
- Wherever possible, solid purging gas chambers are to be used which can be removed after welding. If not possible, only water-soluble paper is to be used.
- Wherever possible, solid purging gas chambers are to be used which can be removed after welding. If not possible, only water-soluble paper is to be used.
- Purging is not required in case of nozzle and attachment welds, when they are not full penetration joints.
- Start purging from inside of pipe when root temperature reaches 220°C. Provide continuous and adequate Argon gas to ensure complete purging in the root area. The minimum pre-flushing time for purging before start of welding shall be 5 minutes, irrespective of the pipe size.
- Preheating: Prior to start of pre-heating ensure that surfaces are clean and free from grease, oil and dirt. Pre-heating temperature shall be maintained at 220°C by using induction heating. The temperature shall be ensured by using a calibrated autographic recorder and two calibrated thermocouples fixed at 0 and 180 degree positions on both pipes 50 mm away from the edge. The thermocouples shall be welded with spot welding machine. The pre-heating arrangement shall be inspected and approved by BHEL engineer. Alternate arrangements shall be made during power failure. Two numbers additional square thermocouple are to be fixed for emergency use. Gas burners shall be employed to maintain the temperature until the power resumes.
- Welding: Root welding shall be done using GTAW process (as per WPS) five minutes after the start of Argon purging. Filler wires shall be clean and free from rust or oil. Argon purging shall be continued minimum two filler passes of SMAW.
- Post Weld Heat Treatment: Heating shall be done by Induction heating only as per the procedure / specifications provided by the BHEL engineers. Generally the PWHT temperatures for T-91/P-91 with T- 91/P-91 material shall be 760 + 10°C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a minimum of two hours. The rate of Heating / Cooling is to be strictly maintained.
- The PWHT temperature shall not deviate from the values specified in the chart range since any deviations to the specified holding temperature range, will adversely affect

the mechanical properties of the weldment and may lead to rejection of the weldment. The weld joints should be kept dry. Under no circumstances any water / liquid is allowed to come in contact with weld as well as preheated portion of the pipe

- The recording of time and temperature shall be continuously monitored with a calibrated recorder right from pre-heating. This shall be ensured at every one hour by site-authorized personnel.
- The width of the thermal insulation beyond the heating band shall be at least two times the heating bandwidth on either side of the weldment.
- All equipment like recorder, thermocouple, compensating cable, oven, thermostat etc. should have valid calibration carried at BHEL approved labs. The calibrated reports should be reviewed and accepted by calibration In-charge at site prior to use.
- Same procedures of welding and heat treatments shall be followed for the weld joints repairs. The NDE shall be conducted for the entire weld joint.
- All the NDE i.e. LPI, MPI, UT and hardness shall be performed on the weld joints as per the standards/ specifications / direction of BHEL. The maximum allowable hardness at weld and parent metal shall be 300 HV10. Joints having hardness above 300 HV shall be re-heat treated and hardness shall be checked again.
- Welders qualified as per ASME Section – IX and IBR on T-91/P-91 material shall only be engaged for the welding of T91/P91 materials. Welders shall have to undergo all the training for above. The welders shall have to be tested and qualified by BHEL site. Contractor shall arrange for the same and entire expenditure towards this shall be borne by the Contractor.
- Contractor shall deploy exclusive Engineer and Supervisor who will be responsible for the completion of all activities from weld fit-up to final clearance of weld joints after satisfactory NDE and acceptance by BHEL / Customer / IBR.
- No interruption is allowed during preheating, welding and PWHT. Hence all equipment for the purpose of power supply, welding, heating etc. hence all alternative arrangements, (Diesel generator for providing power to the welding and heating equipment, reserve thermocouple connections, gas burner arrangement for maintaining temperature etc.) shall be arranged by the contractor within the normal scope of this contract. All the preventions / procedures to be ensured to avoid abruption to on going heating / cooling process. Before start of erection, welding and heat treatment process for P 91 materials all the associated persons shall acquire complete knowledge on the subject from BHEL site engineers to avoid metallurgical failures.
- The Induction heating equipment shall be drawn from BHEL stores, transported, installed and commissioned wherever required at site. For routine and breakdown maintenance, Contractor shall have to deploy sufficient Manpower, Tools & Plants within his quoted rate. The contractor shall provide electrical cables and switches

required. All the equipment shall be protected by providing covers or sheds at site by the contractor within the quoted rate. Any loss / damage of equipment / tools by the contractor shall be recovered from the contractor.

All the consumables to carry out the work for the P91/P92 materials, required for welding and heating process i.e. K type thermocouples fiberglass insulated with heavy duty T/C connector, heating elements (annealing cables), compensating cables, insulating materials (glass fiber cloth temperature rating 1260°C, glass fiber cord dia 3 mm (twisted) temp rating 1260°C, ceramic fiber blanket RT grade density 96 kg / cub M temp rating 1260 °C, ceramic fiber rope fiber glass 12 mm dia.- temp rating 1260 °C), gas burner arrangement, all gases, purging dams, blanks, welding electrodes, filler wires, etc., except those consumables supplied by BHEL units, if any, **shall be in the scope of contractor**.

For carrying out the installation, the following items are being provided by BHEL free of cost, in line with the Special Conditions of Contract Clause :

a) Induction Heating Machine
b) Suitable Power BackUp (DG Set)

The following will have to be provided/supplied by the Contractor within contract scope:

a) Electrodes for P91/P92/T91/T92 welding
b) Spot welding machine
c) Qualified operator for Induction Machine and DG Set
d) All cables for connecting Induction Machine and DG Set to Main Supply along with Changeover System.
e) Welder Qualified as per ASME IX and IBR for T91/P91 Materials. Site Welder Qualification tests will be conducted also.
f) Exclusive Trained Welding Engineer for Supervising T91/P91 Welding and Heat Treatment
g) Qualified NDE Engineer (Level -II) and welding Supervisor (Level-I)
h) UT Testing and Hardness testing
i) Required GTAW and SMAW machines
j) Welding Machine for Demagnetizing along with cable and Residual Field Indicator
k) Providing Enclosure for Welding area suitable for guarding against cold draught, water and dust at all welding locations.
l) Providing of Argon purging for the welding operation (including supply of consumables ex. Water Soluble Paper / Aluminum Dam arrangement.)
m) Providing of Heating by Gas Burner as Standby Arrangement.

n) Providing of Baking ovens and portable ovens
o) Providing Band Saw/ hacksaw/ Grinder for Cutting with tools.
p) Providing machining for Edge preparation
q) Providing of LPI and MPI Facility as specified in the Welding process, including supply of all consumables.
r) Providing and applying insulation band as specified in the welding procedure.

The above comprise of the major requirements for the process. The Contractor has to provide all services and consumables for completion of the work.

DG set for backup power supply, provided by BHEL is to be operated by the contractor bi-weekly / as specified by the supplier to ensure its healthiness during exigencies of power failure for heating processes of T91/P91/P92/T92 materials on account of power failures. Cables and switches, required fuels and other consumables & its operations and maintenance shall be in the scope of contractor within the awarded value.

The contractor shall arrange welding Machine for Demagnetizing material along with cable and Residual Field Indicator

15.39 **Chemical Cleaning**

Chemical cleaning (including chemical supply) will be carried by a separate agency appointed by BHEL. While the work of installation of tanks, Pumps, Piping and operation of the system is in the scope of that agency, the Contractor has to extend all assistance (including providing of a welding power point) and complete interface requirements for the completion of the work.

15.40 For carrying out ultrasonic testing of welded joints of large size tubes and pipes, it will be necessary to prepare the surface by grinding to a smooth finish and contour as desired by BHEL Engineer. The contractor's scope of work include such preparation and no extra charges are payable for this.

15.41 It may also become necessary to adopt inter layer radiography / MPT / UT depending upon the site/technical requirement necessitating interruptions in continuity of the work and making necessary arrangements for carrying out the above work. The contractor shall take all this into account and quote the price inclusive of all such work and radiography.

15.42 The welded surface irrespective of place of welding shall be cleaned of slag and painted at the center with primer paint to prevent corrosion at no extra cost towards this.

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

16.0 **HYDRAULIC TEST**

16.1 The pressure testing for equipment & piping shall be carried out as per IBR / Customer / customers' consultant specification / BHEL. Customers' consultant specification forms the part of this tender specification.

16.2 All equipment and some of the Low Pressure parts shall be subjected to hydraulic test as per the Standard / statutory requirements. The contractor shall supply necessary labour and other services and make necessary arrangements to carry out the required tests as per the instructions and directions of the BHEL Engineers.

16.3 The contractor shall make all necessary arrangements including making of temporary closures on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost.

16.4 Soundness of the welds shall be tested hydraulically under the supervision of the BHEL Engineer and Customer, to the pressure indicated in the drawing. Prior to the test, the boiler / piping system shall be inspected by the BHEL Engineer to the extent necessary to ensure compliance with clearance for the test, which will be obtained by the contractor from the Engineer.

16.5 Hydraulic testing, as required shall be carried out by the contractor. The servicing, installation, electrical connection, erection, testing and dismantling of Hydraulic Test pump, temporary pipelines, fittings, etc. shall be carried out by the contractor as part of this work.

16.6 All the hydraulic tests shall be repeated till all the pipelines / equipment to satisfy the requirements / obligation of BHEL to their customer. As far as the hydraulic pressure test is concerned, the same shall be conducted at various stages to the satisfaction of IBR inspectorate / BHEL / Customer Engineers. Any rectifications required shall have to be done / redone by the contractor at his cost. The contractor shall carry out all the required tests and pre-commissioning and commissioning activities required for successful and reliable operation. These would include hydraulic test of piping, pre-boiler system detergent flushing/chemical cleaning, steam blowing, water washing etc. as instructed by BHEL.

16.7 Test records shall be made for pressure testing of above piping system. These records shall contain the following information:

a) Date of test
b) Identification of piping tested
c) Test fluid
d) Test pressure
e) Approval of the Engineer.

16.8 Contractor has to arrange required pumps with sufficient capacity for filling water in the tubes and pipes for conducting Hydraulic testing of LP lines. Contractor has to arrange Hydraulic Test pump / Hand Pump at his cost for Hydraulic testing of LP lines.

16.9 Contractor shall lay all necessary electric cables and switches etc. required for the hydraulic tests and other tests, flushing etc., and maintain the system till the tests are completed satisfactorily.

16.10 Contractor at his cost shall lay all necessary temporary piping, install the pumps, blanks, valves required for the test, pressure gauges etc. Required pipes, valves, plates etc., will be given by BHEL. Temporary piping, pumps, valves, flanges, blanks etc shall be removed by him and returned to BHEL. All thermowell points are to be seal welded, with plug in position. All Temperature Element points are to be provided with blanks and welded. Necessary blanks will be provided by BHEL.

16.11 Welding and stress relieving of temporary blanks or suitably fixing temporary blank flanges with gaskets and fasteners and welding and providing suitable de-aeration / venting / draining points with valves as per BHEL Engineer's instructions, for performing hydro-test of piping and other equipments is within the scope of work. Gaskets, valves, fasteners will be provided free of cost by BHEL. Contractor shall cut steel blanks from steel provided without charging extra. After completion of hydraulic test, welded blanks shall be cut and removed and weld burrs ground finished and cavities/scars of cutting weld filled and ground as per BHEL Engineer's instructions.

16.12 The contractor shall make all necessary arrangements including making of temporary closures / dummy on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost. Necessary blanks will be provided by BHEL.

16.13 Hanger adjustment / re-adjustment during erection, before and after Hydraulic Test, before and after steam blowing, during and after full load operation, are to be carried out by the contractor within Quoted Rate.

16.14 In general Hydraulic testing of piping shall be performed after all eventual pipe branches have been completed and valves installed. Should it be required to hasten erection work, pressure tests may be performed by sections. For this scope of work, the erected pipe lines shall be hydraulically tested as per site requirement in segments. For conducting hydraulic test, both ends of pipe lines shall be blanked by welding of plates. Only one or two set of plates and structural materials for blanking required for one segment will be provided by BHEL free of charge. After completion of hydraulic test in one segment, the same plates are to be cut and removed and utilized / welded on the other segment of the pipe lines, to carry out the hydraulic test for the respective segments. No separate plates for blanking for each segment will be provided. After completion of Hydraulic test, the required edge preparations shall be carried out on the end of pipe lines and to be welded with the respective pipe lines. In such cases joint connection shall be checked during a final and additional test, if required. The contractor shall note this aspect and quote accordingly.

16.15 During hydraulic test, the pipes being tested shall be isolated from the equipment to which they are connected.

16.16 Openings on piping for pressure / temperature impulse connections shall be fully closed during the test to prevent dust or foreign matter entering into the instrument piping inadvertently.

16.17 During the initial stages of work, trenches for draining water may not be available after Leak test, Hydro test, Flushing or mass flushing. For discharging/ emptying the equipment, system and piping, necessary low point drains and temporary piping up to safe location are be erected by the contractor at his cost. The materials will be provided by BHEL.

16.18 In case any erection defect is detected during various tests / operations, trial runs as detailed above, such as loose components, undue noises, vibration, strain on connected equipment, steam / oil / water leakage, etc. the contractor shall immediately attend these defects and take necessary corrective measures. If any readjustment and re-alignments are necessary the same shall be done as per BHEL Engineer's instructions. If any part needs repairs rectification and replacement the same shall be done by the contractor at no extra cost. If insulation is to be removed to attend any of the defects the cost of removal and reapplication of insulation should be borne by the contractor.

16.19 Temporary blinds / lugs / caps of piping and associated equipment like tanks, pumps etc. required for oil flushing / alkali cleaning / acid cleaning of piping & other equipment during erection & pre-commissioning shall be erected by contractor within the quoted rate.

16.20 During Commissioning, opening / closing of valves, changing of gaskets, attending to leakage and adjustments of erected equipment may arise. Contractor may have to replace old / damaged gaskets / packing etc. for equipment and the same shall be carried out by contractor as per requirement. The finally accepted price / rates shall also include all such work.

16.21 Replacing / cleaning of filters of the erected equipment and piping system etc., during pre-commissioning / commissioning stage is within the scope of work.

16.22 For conducting Hydro test / steam blowing of MS, CRH & HRH internals of valves and NRVs (LPBP, ESV, IV & LP BP Valves & NRVs) are to be removed, Hydro Test devices are to be fixed and after Hydro Test the internals are to be re-assembled by the contractor as instructed by BHEL without any additional cost.

16.23 The pressure testing for piping system shall be carried out as per IBR / Customer / customers' consultant specification / BHEL. Customers' consultant specification forms the part of this tender specification.

16.24 Contractor shall lay all necessary electric cables and switches etc. required for the hydraulic tests and other tests, flushing etc., and maintain the system till the tests are completed satisfactorily.

16.25 Raw materials for all temporary piping necessary for conducting Hydraulic test, Chemical cleaning, Steam blowing, Flushing, effluent disposal, etc. will be provided by BHEL free of cost. However, fabrication, servicing, erection and dismantling the same and return of the temporary piping, flanges, valves etc. to BHEL stores is the responsibility of the contractor without any extra charges.

16.26 The following specifications shall also be completed with during hydrostatic test.

a) Vent nozzles with valves shall be provided at the highest point of the runs, to eliminate air pockets. At the lowest point drain nozzles, with valves shall be provided to drain water from pipes. The nozzles and valves shall be of the same materials as the pipe.

b) The lowest part of the pipe shall always be filled first with water.
c) Pressure shall be slowly increased (without shocks) to the stipulated value and maintained as long as required to visually check all joints.
d) Following the control specified above the pressure shall be slowly decreased to the design pressure after which the pipe shall be subjected to the peening test, applying knocks every 150 mm approx. especially in the welded joint areas, with a 0.5 – 1.5 kg. Hammer (depending on the pipe wall thickness). The hammer used shall be a round headed one.
e) Following the peening test, the pressure shall be increased to the stipulated value and all welded joints shall be visually inspected.
f) Following these test, the pipe shall be drained or pumped out to the other section to be hydro test using the drain out pump to be provided by Contractor and wherever necessary shall be flushed with air for all pipes.
g) The pressure test is considered satisfactory if no cracks, unjustified pressure reductions, leakages, seepages etc., appear.
h) Should defects be found, these shall be repaired in the same manner as these during radiographic examination. Hydraulic test shall be repeated after defects have been repaired.

17.0 APPLICATION OF INSULATION

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

17.1 All attachment welding, including welding of hooks/ supports as per pitch both on equipment and piping shall be done as directed by Engineer. Attachment welding shall have to be done by certified welders. If necessary contractor may have to cut the hooks to correct length. Application of red oxide paint including supply of paint on welded portions as directed by BHEL is also included in the scope of work.

17.2 The contractor has to supply and apply heat resistant primer on welded portions before application of insulation.

17.3 The mineral wool mattresses (bonded/ un- bonded)/ LRB mattresses are received at site in standard sizes. These are to be dressed/ cut to suit site requirements by the contractor.

17.4 The number of layers/ thickness of mineral wool/ LRB mattresses for auxiliaries, pipe lines, valves and other vessels shall be as per various drawings and as directed by Engineer. For applying the mineral wool mattress, the required holding materials, if necessary by fabrication of rings/ hooks shall be fixed as directed and as per drawings and spec.

17.5 Contractor should ensure, proper finishing surface of the insulation, sheeting and cementing.

17.6 Contractor should ensure that the finished surface of the insulation works conforms to the dimensions and tolerances given in the drawings. Aesthetic finish and accuracy of work are most important.

17.7 It is the responsibility of the contractor to ensure that the insulation materials and sheet metal covering issued to him for application are well protected against loss or damage from weather conditions. Closed/ semi-closed sheds or any other arrangements required for this will by him at his cost. If any damage occurs to the material due to improper storage or due to any causes attributable to the contractor except for normal breakage or damages allowed in such cases, the cost of such damaged material shall be to the account of contractor.

17.8 Aluminum sheet cladding will be fabricated to the sizes and shapes specified in drawings. Beading, Swaging, Beveling of sheets, crowning the sheets, if necessary, will be carried out by him. Two coats of anti-corrosive black bituminous paint are to be applied on inner surfaces of the cladding. Bitumen sealing compound on the joints if necessary is included

in the scope of this work. **Contractor may note that he will also supply anti-corrosive black bituminous paint & bituminous sealing compound required for above works at his cost. However, if any material is received from BHEL manufacturing unit, the same shall be issued free of cost to the contractor.**

17.9 Aluminum sheet metal cladding over insulation will consists of plain/ ribbed/ corrugated sheets. The sheets will be supplied in standard sizes. Cutting them to required size, grooving, fabricating bends, boxes etc for proper covering is contractor's responsibility. Any cutting/ bending/ welding of fabricated skin casing sheets if required will also covered within the scope of this contract.

17.10 A log book shall be maintained by the contractor to obtain clearance for application of insulation. If the contractor does the work on his own accord without prior permission the area may have to be redone at his cost.

17.11 Contractor is liable for the exact accounting of the material issued to him and he shall make any unaccountable losses good. Allowed Wastage for the material issued are as below:

1. Wool/ LRB mattresses and cladding sheets 2%

17.12 The entire surplus, unused materials etc supplied by BHEL shall be returned to BHEL after the work is over. Materials like gunny bags and packing materials, empty containers may be returned at periodical intervals.

17.13 The contractor shall leave certain gaps and openings while doing the work as per instructions of BHEL engineer to facilitate inspection during commissioning and to fix gauges, fittings and instruments. The gaps will have to be finished as per the drawings at a later date by the contractor at his cost.

17.14 If during erection and commissioning any of the parts are to be insulated temporarily fixed and then replaced by permanent ones at a later date or if any of the parts are to be removed for modification, rectification, adjustment and then refitted or if some parts are to be opened for inspection, checking and for measurement of metal surface temperature the same may necessitate removal and re-application of insulation and sheet metal cladding, which shall be done by the contractor and the erection rate quoted shall be inclusive of such contingencies.

17.15 Removable type insulation shall be provided for valves, fittings, expansion joints, etc as per the drawing or as directed by BHEL Engineer.

17.16 All temporary pipelines required during testing, pre-commissioning and commissioning should be insulated as directed by BHEL at no extra cost to BHEL. However, required insulation material shall be issued by BHEL free of cost.

17.17 Insulation of expansion joints, dampers, etc shall be carried out after NDT/gas tightness test.

17.18 Day to day cleaning of insulation debris and scraps to be ensured by the contractor. Excessive wastage will attract cost recovery.

17.19 Though for Haridwar scope of equipment and piping, the application of insulation is not in the scope of this contract, but the transportation of the HWR scope insulation and arrangement of scaffolding for the insulation of equipment and integral piping is in the scope of this contract.

18.0 **PAINTING INCLUDING FINISH PAINTING & STENCILING**
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

18.1 The scope of work shall also include supply and application of final painting including stenciling of all the erected equipment as required and specified as per painting schedules for the components of Piping & Other equipment etc.

18.2 Required paints, thinner other consumable such as wire brush, brush etc. shall have to be arranged by the contractor at their own cost. The required manpower, other required consumables, T & P etc shall be provided by the contractor within the quoted rate. The arrangement of primer/paint will be in contractor's scope.

18.3 All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over.

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

18.5 All exposed metal parts of the equipment, structure, auxiliaries, piping, and other items (covered within the scope of this contract) after installations are to be painted after thoroughly cleaning the dust, rust, scales, grease, oil and other foreign materials by wire brushing, scrapping and any other method approved by BHEL Engineer. Mostly the equipment / components installed are with one coat each of primer paint and synthetic enamel / heat resistant paint. However, due to aging, the same may have got deteriorated for peeled off. The surfaces are to be thoroughly cleaned of all dirt, rust, scales, grease, oils and other foreign materials by wire brushing, scrapping, any other method as per requirement of BHEL. The same will be inspected and approved by the engineer before painting.

18.6 After applying the primer paints all structure/ equipment/ items, shall be finish painted with two coats of alloyed resin machinery enamel paints as specified by BHEL engineer. In case proper finish is not obtained in two coats, the contractor shall apply additional coat(s) till proper finish is achieved. Before applying the subsequent coats the thickness of each coat shall be measured and recorded with BHEL / Customer. After completion of painting all bright spots shall be cleaned to the satisfaction of Engineer.

18.7 Certain equipment like control panels, valves etc. shall require spray painting. The contractor shall make arrangements of the required equipment for spray painting. Spray painting at the job site shall be permitted only at times and locations approved by Engineer.

18.8 Contractor at no extra cost to BHEL shall supply all paints, primers, tools and other consumables including scaffolding materials required for finish painting. Paint is to be BHEL/Customer approved make only and painting should be as per colour scheme and quality approved / specified by Engineer. Valid Test Certificate for the paint so supplied shall be made available before use of the same on work. No paint whose shelf life has expired should be used for painting.

18.9 Painting of welded areas / painting of areas exposed after removal of temporary supports / touch-up painting on damaged areas of employer's structures, where inter-connection, welding / modification etc. has been carried out by the bidder.
Clean the surface to remove flux spatters and loose rust, loose coatings in the adjoining areas of weld seams by wire brush and emery paper.
(**Painting procedure to be followed also for touch-up painting on damaged areas**).

18.10 The contractor may be required to fill up dents / marks by applying putty before final painting of equipment. All materials and arrangements have to be made within quoted lump sum price/rates.

18.11 The contractor shall provide legends with direction of flow on equipment and piping in size specified by Engineer. Letter writing shall be done in Hindi / English or in both languages.

18.12 The painters have to undergo test on a mock plate of size 1m*1m and only qualified painters will be allowed to work.

18.13 The contractor shall ensure availability of

- Ford Cup-4 to measure consistency of paint,
- Automatic magnetic gauge/Elcometer to measure the dry film thickness and
- SSPC Visual standards to assess degree of cleanliness of surfaces to be painted.

18.14 All paints should be stored in well-ventilated store. The painters and other personnel deployed should use proper protective equipment to avoid inhalation of fumes.

18.15 The Turbines, Generator and all auxiliaries of this contract scope, are also to be painted as per the paint schedules.

18.16 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. Elcometer for measuring the thickness of paint applied is to be arranged by the contractor.

18.17 Finish coat paint, No of coat and DFT shall be as indicated in the painting specification enclosed in this tender / relevant BHEL document/ customer's specifications. The painting specification which is forming part of this tender as in TCC shall be used as guidelines to be followed.

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

18.19 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. The batch certificates of paints to be submitted to BHEL Engineer before using the same.

18.20 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.

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

18.22 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL/ Customer. **The instrument for checking the thickness of coats (DFT measurement, Elcometer) to be procured by the contractor and should be calibrated after periodical intervals.**

18.23 Wherever applicable, supply and application of primer / final painting of all the insulation items erected under the scope of this tender. The painting shall be as required and specified in the painting schedule.

18.24 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and

application of bituminous sealing compound on cladding/ sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, thinner and other accessories for painting, cleaning the surfaces etc., shall be arranged by the contractor within the quoted rate.

18.25 The contractor shall effectively protect the finished work from action of weather and from damage of defacement and shall cover the finished parts, then and there, for their protection.

18.26 **CONDENSER PAINTING**

a) The condenser main tube plates will be dispatched to site from the works with surface protection only on water box side. The same shall be removed adopting one of the suitable methods indicated elsewhere in this specification. The contractor shall do the surface protection of these tube plates after the completion of the tube insertion and expansion activities. The surface shall be first painted with at least two or more coats of approved quality chemical resistant epoxy zinc chromate primer after thoroughly cleaning all such parts of al dirt, rust scales greases, oils and other foreign materials by adopting suitable methods as approved by BHEL. Afterwards the above parts shall be finished with two or more coats of approved quality high build black coal tar coating. Before the painting is taken up, the contractor shall plug all the holes with suitable tapered plastic / wooden plugs to avoid any damage to the tube ends. The plastic / wooden plugs and paints required for the above operations shall have to be arranged by the contractor at his cost. **The above paints are also to be applied on water chamber / box.** The thickness is to be confirmed by suitable measurement. **The inside of water box has to be painted with High build Black Coal Tar epoxide paint of thickness DFT= 0.25mm or as per painting procedure.**

b) The condenser steam space shall be surface protected with at least two coats of suitable steam washable paint. Before the painting is taken up, the contractor shall clean the surfaces to be coated by adopting suitable methods. The contractor at no extra cost shall procure paint to BHEL

PRESERVATION / TOUCH UP PAINTING

18.27 Contractor shall carryout cleaning and preservation / touch up painting for the materials / equipment under this tender specification right from pre- assembly stage to till the equipment is cleared for final painting. The primer paint shall be matching shop primer.

18.28 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 same primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.

18.29 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.

18.30 Required paints, thinner other consumable such as wire brush, brush etc. shall have to be arranged by the contractor at their own cost. The required manpower, other required consumables, T & P etc. shall be provided by the contractor within the quoted rate. The arrangement of primer/paint will be in contractor's scope.

18.31 Painting of portions of Employer's structures wherever connection/welding is carried out by contractor for supporting structures.

18.32 All rectification including painting of Employer's structure which are damaged by contractor during his work.

19.0 TESTING , PRE-COMMISSIONING & COMMISSIONING AND POST COMMISSIONING
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

19.1 Contactor shall carry out all the required tests and pre-commissioning and commissioning activities required for their successful and reliable operation. Specific omission of any test which is required for the successfully commissioning all the equipment's covered under scope does not absolve the contractor of its responsibilities of performing of that test.

19.2 Trial run of FEED PUMPS, CEP, and various rotating machineries / pumps.

19.3 Trial run and commissioning of motors/ drives for various auxiliaries. This includes testing of motors including CT testing, actuators etc, with supply of test kits.

19.4 Hydraulic test of pipelines, closed systems, tanks and vessels. Any calibrated pressure gauges required for the hydrotests are to be arranged by the contractor at his cost.

19.5 Flushing of all pipelines by air/oil/water/steam as the case may be.

19.6 Servicing of all valves and fittings.

19.7 Manual/ mechanical cleaning of Oil Tanks, Deaerator, FST, Suction strainers /filter elements of CEP, BFP, Booster pump and other various equipments and tanks erected by the contractor. This may have to be repeated several times during the commissioning process.

19.8 BARRING GEAR.

19.9 ROLLING AND SYNCHRONISATION.

19.10 FULL LOAD OPERATION.

19.11 TRIAL/INITIAL OPERATION

19.12 These would also include hydraulic test of condenser and water flushing of piping, oil flushing of oil system etc. as instructed by BHEL.

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 which are supplied by Manufacturer's as special T&P for Erection and Commissioning shall be provided by BHEL / its client free of hire charges. However contractor has to take proper care of the equipment issued to him.

Any other T&P, MME, Precision equipment, Testing kit other than that provided by BHEL/client has to be arranged by contractor, as and when required with no extra cost to BHEL, and ensuring uninterrupted flow of work.

19.13 The contractor shall carry out the air-tightness test on assembled generator to the satisfaction of BHEL Engineer. The necessary arrangement for testing with dry-clean air shall be made by the contractor at his cost. Compressed air for testing can be taken by the contractor from the existing system.

19.14 **Helium Leakage Test-** The contractor shall carry out the Helium Leakage Test on assembled generator to the satisfaction of BHEL Engineer. The necessary arrangement/ test kit for carrying out the Helium Leakage test shall be made available by the contractor at his cost.

19.15 All the tests may have to be repeated till all the equipment satisfy the requirement / obligation of BHEL at various stages. The contractor shall repairs all joints (shop welded or site welded) failed during testing.

19.16 While the Detergent cleaning operation including the required looping in piping , draining and disposal will be carried out by another agency , the Contractor will have to ensure the readiness and availability of CEP ,associated systems and the piping which is erected under this scope and is to be cleaned . Any work required on the permanent system will have to be carried out by the Contractor. Cleaning of strainers and any support required for detergent flushing of the systems/equipment which come under this contract has to be done by the contractor.

19.17 All temporary piping along with their supports for steam blowing in the systems erected by the Contractor, and the required loops for chemical cleaning of the piping erected by the contractor will have to be erected within the quoted rates.

19.18 For completing the chemical cleaning/oil flushing contractor may have to do some temporary piping /welding will be in the scope of work.

19.19 The Contractor will also be responsible for their installation wherever required. He will dismantle the total system and return the same to BHEL / their customer store as

directed. No separate payment will be released for erection & dismantling of the required equipment & piping.

19.20 Thermal shocks will be required during oil flushing operations. The contractor is required to make all arrangements for the same. This would include fabrication of heating tank with nozzles and requisite piping with supports. Complete erection with pumps, tanks, electrical fittings including and other accessories is to be carried out. All material and equipment will be provided on returnable basis by BHEL.

19.21 The scope of pre-commissioning activities cover installation of all necessary temporary piping, supports, valves, blanking, pumps, tanks etc. and other accessories with access platforms valves, pressure gauges, electric cables, switches, cutting of some of existing valve, placing of rubber wedges in the valves etc., required for hydro test, steam blowing or for any other tests as the case may be and will carry out above activities under this scope of work as per instructions of BHEL. The scope also covers the offsite disposal of effluents.

19.22 All arrangement required for steam blowing including removal, reinstallation and welding of CRH NRV and installation of steam blowing arrangements, temporary piping including steam blow off piping is included in the scope of work.

19.23 It shall be the responsibility of the contractor to preserve the cleaned surface as per BHEL's requirement.

19.24 The pre-commissioning activities will start prior to oil flushing of the TG and various trials, commissioning operations shall continue till the TG is handed over to customer. Simultaneous commissioning checks, activities will be in progress in various areas like trial run of various equipment, checking of equipment erected, making ready for trial runs, filling up of lubricants, Chemicals etc.

19.25 All these works need specialized gangs including electricians, instrument technicians, and fitters, in each area to render assistance to BHEL commissioning staff. Contractor shall earmark separate manpower for various commissioning activities. This manpower shall not be disturbed or diverted. The mobilization of these commissioning gangs shall be sufficient so that planned commissioning activities are taken up in time and also completed as per schedule and the work is to be undertaken round the clock if required.

19.26 Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

19.27 All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests/ activities may not have been listed in these specifications.

19.28 Specialized test equipment, if any, shall be provided by BHEL/ Customer free of hire charges. However, contractor has to take proper care of the equipment issued by him.

19.29 All the tests may have to be repeated till all the equipment satisfy the requirement /obligation of BHEL at various stages. The contractor shall do all the repairs for site-welded joints arising out of the failure during testing.

19.30 Scope of pre-commissioning activities cover installation of all necessary equipment including temporary piping, supports, valves, blanking, pumps, tanks, etc and other accessories with access platforms valves, pressure gauges, electrical cables, switches, cutting of some existing valve, placing of rubber wedges in the valves, etc, required for hydro test, or for any other tests as the case may be and will carry out above activities under this scope of work as per instruction of BHEL Engineer.

19.31 It shall be the responsibility of the contractor to provide various category 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. Contractor will provide necessary consumables, Certified T&P's, IMTE's 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.

19.32 It shall be specifically noted that the above employees of the contractor may have to work round the clock along with BHEL Engineers and hence overtime payment by the contractor to his employees may be involved. The contractors finally accepted rates should be inclusive of all these factors also.

19.33 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.

19.34 During commissioning, opening / closing of valves, changing of gaskets, realignment of rotating and other equipment, attending to leakage and adjustments of erected equipment may arise. The finally accepted price / rates shall also include all such work.

19.35 Contractor shall make all necessary arrangements including making of temporary closures on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost.

19.36 The water boxes of the condenser will be tested hydraulically to 1.5 or 1.3 times (OR as per NTPC requirement) the design pressure after its assembly at site. The arrangement of all the blanking for carrying out the hydraulic test shall be the responsibility of the contractor at no additional cost. However only the main blanking flanges with fasteners for CW inlet and CW outlet of the condenser shall be provided by BHEL free of cost. Fabrication of blanks will be carried out by the contractor.

19.37 The water-fill test of the steam space shall be carried out by filling the water upto 300 mm above the final joint of the exhaust hood with the turbine or as required above the top row of tubes to facilitate leak detection. It should be done so that all the field welding joints are covered in the test. Hydraulic testing shall be carried out on the condenser water boxes. Dummy plates shall be provided by BHEL.

19.38 The contractor shall fill the condenser upto the specified level as many times as called for by the Engineer for checking of the turbine at no additional cost

19.39 Valves will have to be checked, cleaned or overhauled in full or in part before erection, after acid cleaning, steam blowing and during commissioning as may be necessary.

19.40 In case any defect is noticed during tests, trial runs and commissioning such as loose components, undue noise or vibration, strain on connected equipment etc., the contractor shall immediately attend to these defects and take necessary corrective measures. If any readjustment and realignment are necessary, the contractor at his cost shall do the same as per Engineer's instructions including repair, rectification and replacement work. The parts to be replaced shall be provided by BHEL.

19.41 All temporary supports shall be removed in such ways that pipe supports are not subjected to any sudden load. During hydraulic testing of pipes, all piping having variable spring type supports shall be held securely in place by temporary means while constant spring type support hangers shall be pinned or blocked solid during the test.

19.42 The contractor shall carry out cleaning and servicing of valves and valve actuators prior to pre-commissioning tests and / or trial/initial operations of the plant. A system for recording of such servicing operations shall be developed and maintained in a manner acceptable to BHEL Engineer to ensure that no valves and valve actuators are left un-

serviced. Wherever necessary as required by BHEL Engineer, the contractor shall arrange to lap / grind valve seats.
Cleaning and servicing of all the filters / strainers, toppings of oils coming in the system shall be done by the contractor within the accepted price.

19.43 At the time of each inspection, the contractor shall take note of the decisions / changes proposed by the Engineer and incorporate the same at no additional cost. The contractor shall carry out any other test as desired by BHEL Engineer/ Manufacturer on erected equipment covered under scope of this contract during testing and commissioning to demonstrate the physical completion of any part or parts of the work performed by the contractor

19.44 Scope of pre-commissioning, commissioning and post commissioning activities cover installation of all necessary temporary piping, supports, valves, blanking, pumps, tanks etc. and other accessories with access platforms valves, pressure gauges, electric cables, switches, cutting of some of existing valve, placing of rubber wedges in the valves etc., required for hydro test, or for any other tests as the case may be and will carry out above activities under this scope of work as per instructions of BHEL. Any temporary fasteners, gaskets etc, if required to be provided for commissioning of the system, are under the scope of this contract within the quoted rates.

19.45 The contractor shall make all necessary arrangements including making of temporary closures on piping/ equipment for carrying out the hydro-static testing on piping equipment covered as per the scope at no additional cost. The contractor shall carryout the required test on the pipelines such as Hydraulic Test (as per IBR requirement/ instruction of BHEL), of piping systems as per the scope, Ultrasonic Test for weld defects and finding thickness, Dye penetrant test, Magnetic particles test for Weld defects and materials defects etc. All facilities (manpower, materials, equipment, consumables etc.) including proper approaches wherever required shall be provided by the contractor for satisfactory conduction of above tests. Special equipment such as magnetic particle tester, ultrasonic test kit and engineers required for these tests shall be arranged by the contractor along with qualified technician within finally accepted rates.
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.

19.46 All the above tests should be repeated till all the erected piping satisfy the requirement/obligation of BHEL and Boiler Inspectorate, if required at various stages. All the repair for site welded joints arising out of the failures during testing shall be done by the contractor as part of the work within finally accepted rates.

19.47 Commissioning of electrically operated actuators for valves, dampers, gates, etc. are under the scope of this contractor. Pneumatic actuator will be commissioned by other agencies of BHEL. All the required support will in the scope of this contract.

19.48 Valves will have to be checked, cleaned or overhauled in full or in part before erection, alkali flushing, steam blowing and during commissioning as may be necessary.

19.49 Suitable welding and stress relieving of temporary blanks or suitably fixing temporary blank flanges with gaskets and fasteners and welding and providing suitable de-aeration/ ventilation draining points with valves as per BHEL Engineer's instruction, for performing hydro test of piping and other equipment, is within the scope of this specification. Gaskets, valves, fasteners, blank flanges, blanks or steel for blank flanges will be provided free of cost by BHEL. Contractor shall cut out steel blanks from steel provided. After completion of Hydraulic Test, welded blanks shall be cut and removed and weld burrs ground finished and cavities/ scars of cutting weld filled, ground as per BHEL Engineer's instruction at no extra cost. NDT & SR if required may have to be carried out.

19.50 Hydro test of piping has to be repeated several times in consonance with technical/statutory requirements during stage of erection pre commissioning/ commissioning. Hydro test will have to be done to the satisfaction of Boiler Inspector/ Customer/ BHEL Engineer after attending repairs, Hydro test shall be repeated before Boiler Inspector/customer/ BHEL engineer to their satisfaction.

19.51 The contractor shall carry out any other tests as desired by BHEL engineers on erected equipment covered in the scope of this contract during testing and commissioning to demonstrate the satisfactory completion of any part or whole of work performed by the contractor. During Hydraulic Test, the pipes being tested shall be isolated from the equipment to which they are connected.

In certain places blanking has to be resorted prior to Hydraulic test and spool pieces have to be erected in place of control valves, orifices and other fittings and these spool pieces have to be subsequently replaced with the regular valves/ fittings by the contractor at no extra cost.

19.52 During this period though the BHEL's/ client's staff will also be associated in the work, the contractor's responsibility will be to arrange for the complete requirement of supervision, consumables, labour, T&P and IMTEs required till such time the commissioned units are taken over by the BHEL's customer.

19.53 It is possible that due to any reason the final supporting may not be completed before conducting Hydraulic Test. The contractor may have to strengthen or install any additional supports as per instruction of BHEL. This work is a part of the work and no additional payment shall be made on this account.

19.54 During commissioning changing of gaskets , tightening of bolts, realigning of rotating and other equipment, attending to leakage and minor adjustments of erected equipment may arise. The quoted rate of contractor shall be inclusive of all such works.

19.55 The instruction of the motor manufacturer regarding storage of the motors and re-conservation must be strictly followed without any deviation.

19.56 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 programs made to achieve the schedule agreed with customer.

19.57 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 for a period of six months after synchronization or till handing over of sets to customer, whichever is earlier.

19.58 After synchronization, the commissioning activities and trial/initial operations will continue till handing over of the unit. Contractor shall provide the manpower for three months from trial/initial operation or submission of final bill with material reconciliation whichever is later. It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers as per the work requirement along with supervisors including necessary consumable tools etc., during this period. The rate quoted shall indicate all these contingencies also. The various categories of workers required for pre-commissioning, commissioning and post-commissioning activities are as follows:

a) Pipe fitters
b) Millwright Fitters
c) HP& structural welders
d) Riggers
e) Unskilled workers
f) Supervisors
g) Electricians
h) Laggers

i) Sheet metal fabricator/fitter
j) Any other category of workers as may be required.

Further in addition to the above, contractor has to arrange the following minimum manpower exclusively for assisting BHEL commissioning engineers during stabilization and trial/initial operation period. This manpower will be directly controlled by BHEL commissioning engineers.

1. One supervisor per shift for three shifts.
2. Two fitters per shift for three shifts.
3. Two helpers per shift for three shifts.

It shall be specifically noted that the above employees of the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL commissioning Engineers and hence, overtime, may be involved. The contractor‘s quoted rate shall be inclusive of all these factors also.

19.59 During commissioning any improvement or rectification due to design requirement is involved and if the contractor is asked to carry out the job, they shall be paid at man-day rates as per GCC clause no. 2.15. For this purpose, daily labour report indicating therein nature of work carried out, consumables used, etc. shall be maintained by contractor, and got signed by BHEL Engineer every day. It is not obligatory on the part of BHEL to get the works done by the contractor. They can employ any other agency if they so desire at that time.

19.60 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.

19.61 The contractor has to provide required man power assistance during pre-commissioning and commissioning checks of motor operated valves, actuators, control valves etc. without any extra charges.

19.62 Necessary scaffolding and approaches for conducting the above shall also be within the scope of the contract.

19.63 During this period, though BHEL's and customer's staff also be associated in the work, it is the contractor's responsibility to make available the resources in his scope till such time the commissioned units are taken over by the customer / BHEL.

Annexure-I

UNPRICED RATE SCHEDULE

ITEM NO.	DESCRIPTION OF WORK	TOTAL VALUE "A" IN INR (IN FIGURES AND WORDS)
1.0	TOTAL PRICE FOR THE TOTAL WORK OF "ERECTION,TESTING, COMMISSIONING, TRIAL OPERATION AND HANDING OVER OF STEAM TURBINE, GENERATOR, INTEGRAL PIPING, 3x1500 KVA EMERGENCY DG SET, HP & LP PIPING AND OTHER AUXILIARIES OF THE SYSTEM INCLUDING BOIs etc. AND FINAL PAINTING OF THE UNIT INCLUDING SUPPLY OF PAINTS for Unit#2 AT 2X660 MW KHURJA STPP" U. P. AS PER TENDER SPECIFICATIONS.	
Notes:		
1.	The rates of individual item for the entire scope of work as defined in BOQ Chapter X, shall be arrived as per Calculation defined in Annexure-II.	
2.	The derived item rate will remain firm throughout the contract period	

Notes:

i. Bidder's quoted price above shall be complete in all respect for the full scope defined in specification and in accordance with all terms & conditions of tender.
ii. Contractor shall fully understand description and specifications of items mentioned in BOQ.
iii. Conditional price bids with any deviation / clarification etc. are liable to be rejected. No cutting / erasing / over writing shall be done.
iv. Quantities mentioned in rate schedules (Annexure-II) are approximate only and liable for variation on either side depending upon site / design requirement. The contractor undertakes to execute actual quantities as per advice of BHEL Engineer and accordingly the final contract price shall be worked out on the basis of quantities actually executed at site and payments will also be regulated for the same.
v. The contractor while quoting the above rates, categorically confirms having understood the fullest implications of price escalation provisions contained in tender. Accordingly taking into consideration all aspects thereof quoted above rates. Further contractor confirms that he will not come with any other claim/compensation on account of any increase whatsoever during the entire period of execution including extended period if any.
vi. Taxes (GST) shall be payable extra as per relevant clauses in Technical Conditions of Contract.

Annexure-II

Calculation ratio for different items based upon the Total Price as per Annexure- I

Sl. No	DESCRIPTION OF WORK (As per Chapter-X of TCC)	Qty.	Unit	FACTOR (F)	Amount (B)= F *A	Rate (INR) per MT = Amount(B)/ Qty
A.1	**Lumpsum PRICE OF STG PACKAGE (including all auxilliaries) for Khurja**	1	LS	**52.738%**		
Rate Schedule for Piping & Insulation						
A.2	**LP Piping**	569	MT	**9.839%**		
A.3	**HP Piping**	1235	MT	**34.254%**		
A.4	**SS Piping**	3	MT	**0.155%**		
A.5	**Insulation**	274	MT	**3.014%**		
	TOTAL AMOUNT "A" (INR)					

21.1 NTPC Safety Rules for Construction and Erection of Power plants (Enclosed as Separate attachment, Annexure- IV)

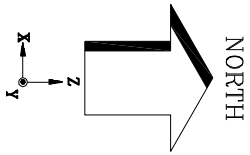
The vendor has to adhere the safety guideline as per HSE manual of BHEL and the safety rules attached as Annexure-IV. In case of any contradiction between the two, the stricter provision shall be applicable. BHEL's decision in this regard shall be final and binding on the contractor.

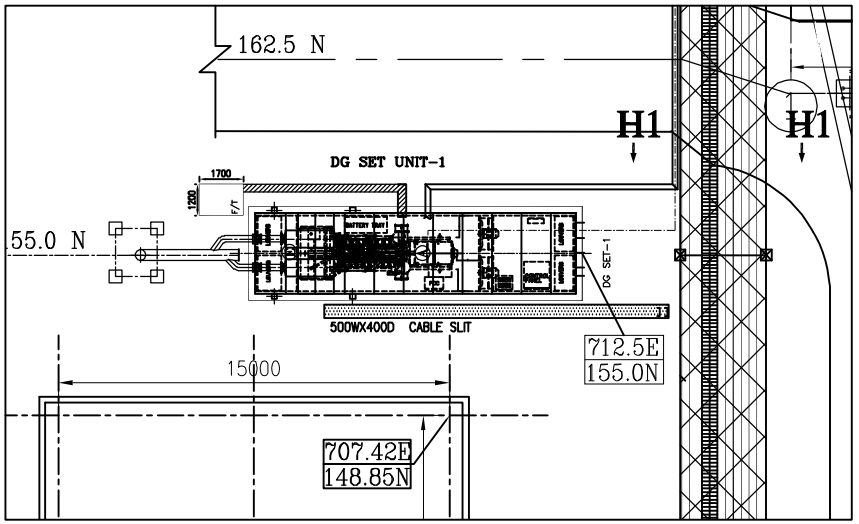
21.2 The NTPC Color and Coding Scheme (QS-01-DIV-W-4) for Equipment and Piping is attached as Annexure-V. Vendor will have to supply and apply paints as per the above code/documents, in consultation with BHEL.

DG SET- LAYOUT DRAWING

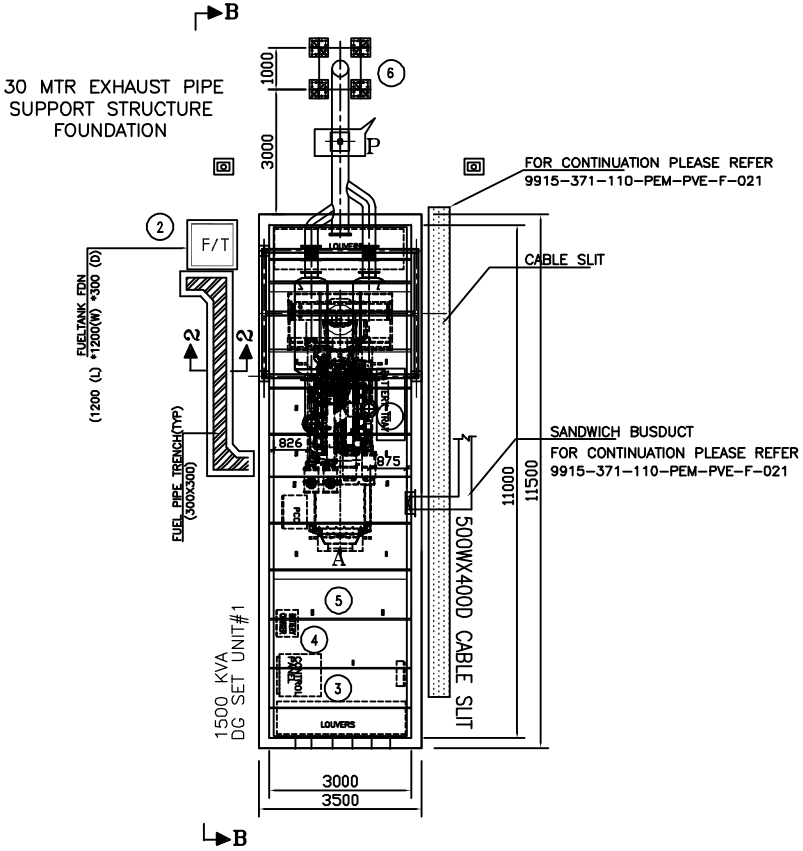
&

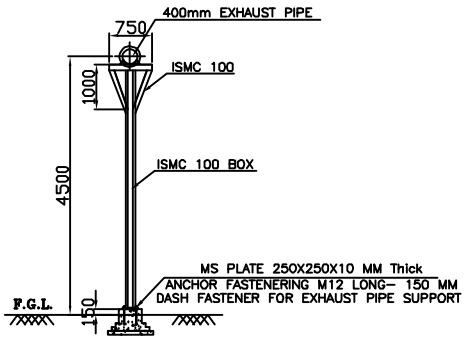
SECTIONAL DETAIL





KEY PLAN



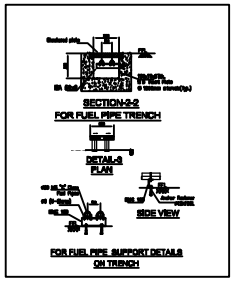


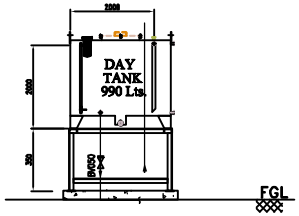
DETAILS-P
(TYP.) MOUNTING OF
SUPPORT EXHAUST PIPE

NOTE:-

50 MM INSULATION WITH 24 GAUGE ALUMINIUM CLADING FROM DG SET SILENCER AND EXHAUST PIPE UP TO 30 MTR OF STACK.

S.NO.	DESCRIPTION	SCOPE
1	24 V-360 Ah LEAD ACID BATTERY- 2 SETS PER DG	BHEL
2	FUEL DAY TANKS (990 Ltrs) - 3NOS. (1000x1000x1000)	BHEL
3	DG AMF PANEL 800(W)x2030(H)x1000(D)- 3 NOS	BHEL
4	BATTERY CHARGER 600(W)x500(D)- 1 NO PER DG.	BHEL
5	DG SET WITH ENCLOSURE 10.5mx3.25Mx3.835m - 3NOS.	BHEL
6	EXHAUST PIPE AND SUPPORT STRUCTURE	BHEL





REFERENCE DRGS.

SL NO.	TITLE	DRG NO	SOURCE
1.	PLOT PLAN		PEM/MECH
2.	TRANSFORMER YARD LAYOUT	9915-371-110-PEM-PVE-F-021	PEM/ELECT
3.	FOUNDATION PLAN FOR DG SET	9915-371-110-ISG-PVM-Y-005	ISG
4.	GA OF EXHAUST PIPE SUPPORT STRUCTURE	9915-371-110-ISG-PVM-B-004	ISG
5.	GA OF DG SET, ACOUSTIC ENCLOSURE AND FUEL TANK	9915-371-110-ISG-PVM-B-002	ISG
6.	GA AND LAYOUT OF SANDWICH BUSDUCT		SBD

LEGEND:

- CABLE TRENCH
- OPERATING FRONT OF THE PANEL
- LTP LT POWER CABLE
- LTC LT CONTROL CABLE
- IC INSTRUMENTATION CABLE
- TREATED EARTH PITS
- CABLE SLITS

NTPC DRAWING NO. 9915-371-110-ISG-PVM-B-006

OWNER: THDC INDIA LIMITED
(A JV of GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT: NTPC LIMITED
(A GOVT. OF INDIA ENTERPRISE)

PROJECT: KHURJA SUPER THERMAL POWER PROJECT (2 X 660MW)
(TURBINE GENERATOR & ASSOCIATED PACKAGES)

CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

JOB NO.	IS-1-19-2024
STATUS	CONTRACT
DRG./REF. NO. (INTERNAL)	
PRINT SCALE IN METRE	

DEPT CODE	DRAWING	NAME	SIGN	DATE
C	ORIG			
	CHD			
	APPD			

TITLE: DG SETS-LAYOUT DRG & SECTIONAL DETAILS

MPL	ELEC	C&I	MSE	MAX	DEPT. SIGN DATE	SCALE VARIES

DRAWING NO. IS-3-DG-750-800-A010

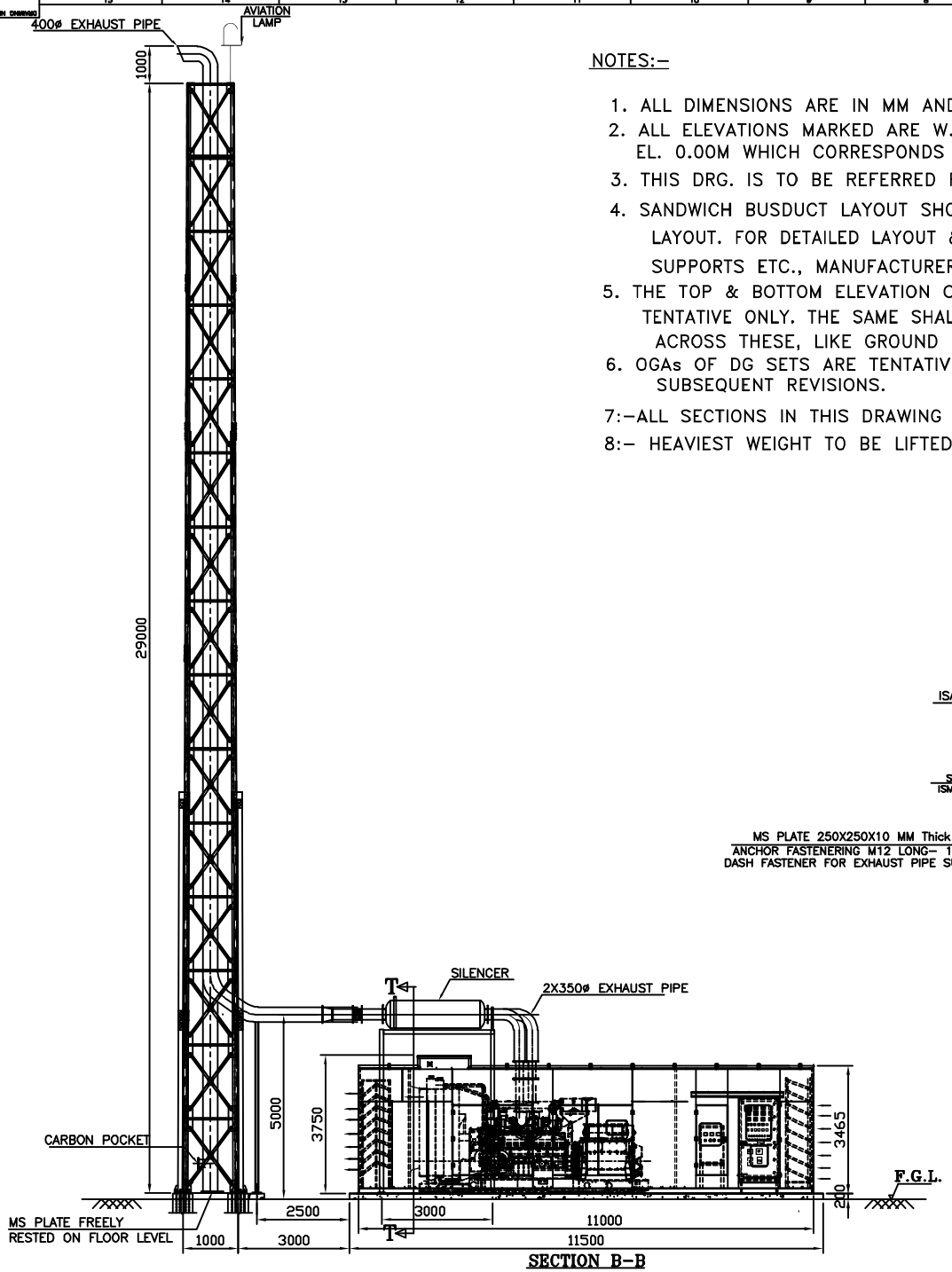
SHEET 1 OF 4 REV 00

NOTES:–

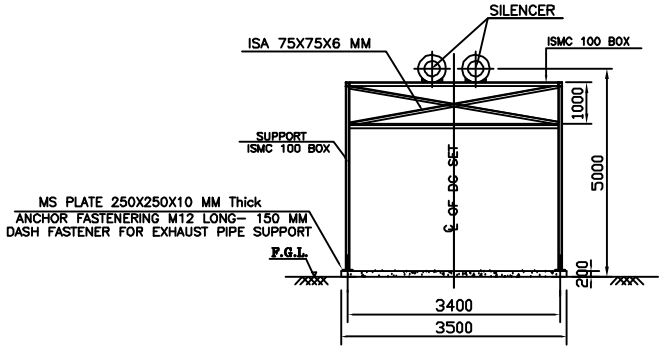
1. ALL DIMENSIONS ARE IN MM AND ELEVATIONS ARE IN METRES.
2. ALL ELEVATIONS MARKED ARE W.R.T. FINISHED FLOOR LEVEL (FFL) OF POWER HOUSE BUILDING GROUND FLOOR IS EL. 0.00M WHICH CORRESPONDS TO RL (+)194.5M.
3. THIS DRG. IS TO BE REFERRED FOR LAYOUT OF DG SETS AND ASSOCIATED EQUIPMENT.
4. SANDWICH BUSDUCT LAYOUT SHOWN IN THIS DRAWING IS FOR THE PURPOSE OF ESTABLISHING THE GENERAL ROUTING AND LAYOUT. FOR DETAILED LAYOUT & DETAILS OF CUTOUTS IN CLADDING/ WALL FOR BUSDUCT ENTRY, FOUNDATION SUPPORTS ETC., MANUFACTURER'S DRAWINGS SHALL BE APPLICABLE.
5. THE TOP & BOTTOM ELEVATION OF CABLE TRENCHES/ DUCT BANKS/ CABLE SLITS ETC. INDICATED IN DWG. ARE TENTATIVE ONLY. THE SAME SHALL BE FIXED BY CIVIL (PEM) BASED ON THE REQUIREMENT OF OTHER UTILITIES RUNNING ACROSS THESE, LIKE GROUND DRAINAGE OIL DRAIN PIPES, FIRE HYDRANT TRENCHES, X'MER TANKS, ROAD ETC.
6. OGAs OF DG SETS ARE TENTATIVE AND SHALL BE UPDATED AS PER MANUFACTURER DRAWINGS IN SUBSEQUENT REVISIONS.

7:–ALL SECTIONS IN THIS DRAWING IS NOT MADE TO SCALE.

8:– HEAVIEST WEIGHT TO BE LIFTED IS ENGINE OF 6 TONS



SECTION B–B



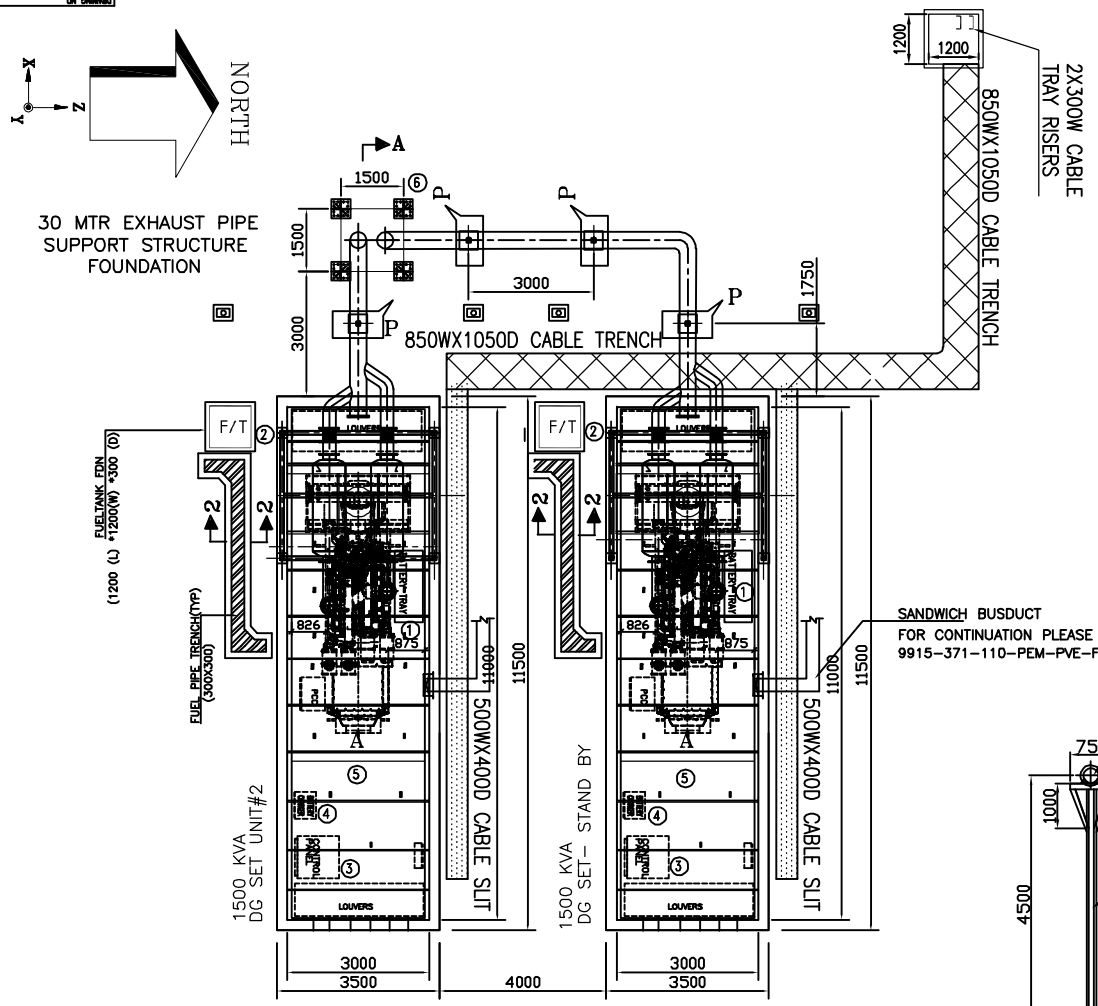
SECTION–T–T
SILENCER MOUNTING OF SUPPORT STRUCTURE

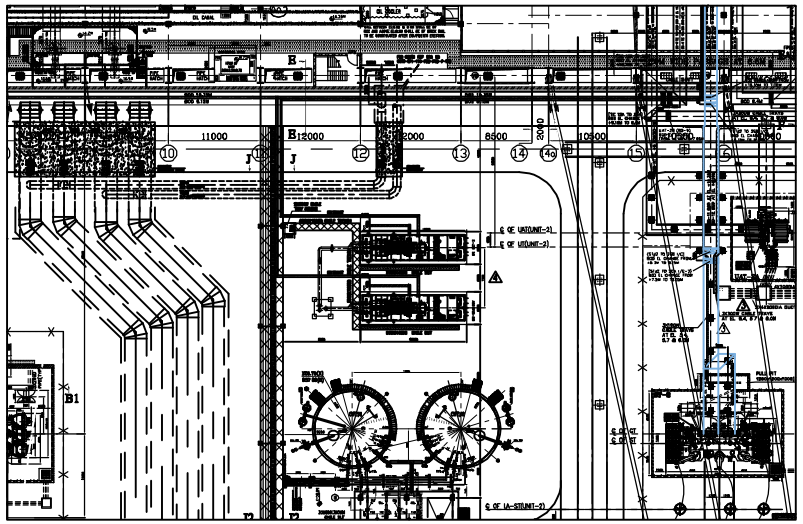
NTPC DRAWING NO.	9915-371-110-ESC-PVM-B-006
CONSULTANT	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)
	NTPC LIMITED (A GOVT. OF INDIA ENTERPRISE)
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2 X 660MW) (TURBINE GENERATOR & ASSOCIATED PACKAGES)
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI
JOB NO.	IS-1-19-2024
STATUS	CONTRACT
TITLE	DG SETS–LAYOUT DRG & SECTIONAL DETAILS
DRAWING NO.	IS-3-DG-750-800-A010
SCALE	VARIES
SHEET	2 OF 4
REV	00

PE-DG-476-XXXX

NORTH

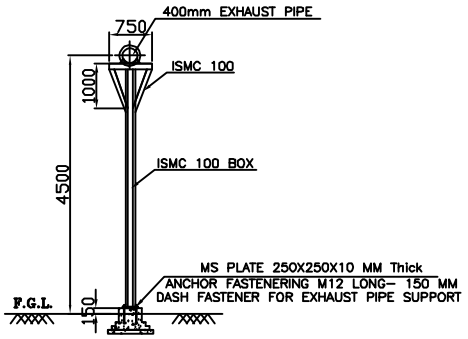
30 MTR EXHAUST PIPE SUPPORT STRUCTURE FOUNDATION



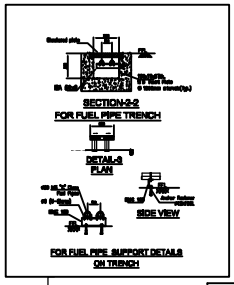


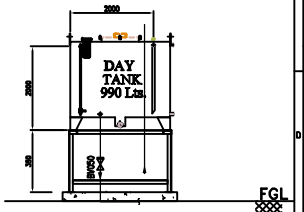
KEY PLAN

S.NO.	DESCRIPTION	SCOPE
1	24 V-360 Ah LEAD ACID BATTERY- 2 SETS PER DG	BHEL
2	FUEL DAY TANKS (990 Ltrs) - 3NOS. (1000x1000x1000)	BHEL
3	DG AMF PANEL 800(W)x2030(H)x1000(D)- 3 NOS	BHEL
4	BATTERY CHARGER 600(W)x500(D)- 1 NO PER DG.	BHEL
5	DG SET WITH ENCLOSURE 10.5mx3.25Mx3.835m - 3NOS.	BHEL
6	EXHAUST PIPE AND SUPPORT STRUCTURE	BHEL



DETAILS-P
(TYP.) MOUNTING OF
SUPPORT EXHAUST PIPE





NOTE:-

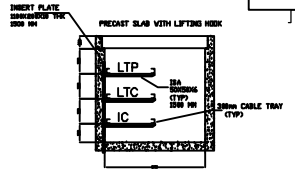
50 MM INSULATION WITH 24 GAUGE ALUMINIUM CLADING FROM DG SET SILENCER AND EXHAUST PIPE UP TO 30 MTR OF STACK.

REFERENCE DRGS.

SL NO.	TITLE	DRG NO	SOURCE
1.	PLOT PLAN		PEM/MECH
2.	TRANSFORMER YARD LAYOUT	9915-371-110-PEM-PVE-F-021	PEM/ELECT
3.	FOUNDATION PLAN FOR DG SET	9915-371-110-ISG-PVM-Y-005	ISG
4.	GA OF EXHAUST PIPE SUPPORT STRUCTURE	9915-371-110-ISG-PVM-B-004	ISG
5.	GA OF DG SET, ACOUSTIC ENCLOSURE AND FUEL TANK	9915-371-110-ISG-PVM-B-002	ISG

LEGEND:

- CABLE TRENCH
- CABLE TRAY RISER
- OPERATING FRONT OF THE PANEL
- LTP LT POWER CABLE
- LTC LT CONTROL CABLE
- IC INSTRUMENTATION CABLE
- TREATED EARTH PITS



CABLE TRENCH DETAILS

NTPC DRAWING NO. 9915-371-110-ISG-PVM-B-006

ENTERPRISE	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)
CONSULTANT	NTPC LIMITED (A GOVT. OF INDIA ENTERPRISE)
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2 X 660MW) (TURBINE GENERATOR & ASSOCIATED PACKAGES)
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NEW DELHI
TITLE	DG SETS-LAYOUT DRG & SECTIONAL DETAILS

JOB NO.	IS-1-19-2024
STATUS	CONTRACT
DRG./REF. NO. (INTERNAL)	
PRINT SCALE IN METRE	

DEPT CODE	DRAWING	NAME	SIGN	DATE
C	ORIG			10.06.22
	CHD			10.06.22
	APPD			10.06.22

MPL	ELEC	C&I	MSE	MAX	DEPT. SIGN DATE	SCALE VARIES	DRAWING NO. IS-3-DG-750-800-A010

SHEET 3 OF 4 REV 00

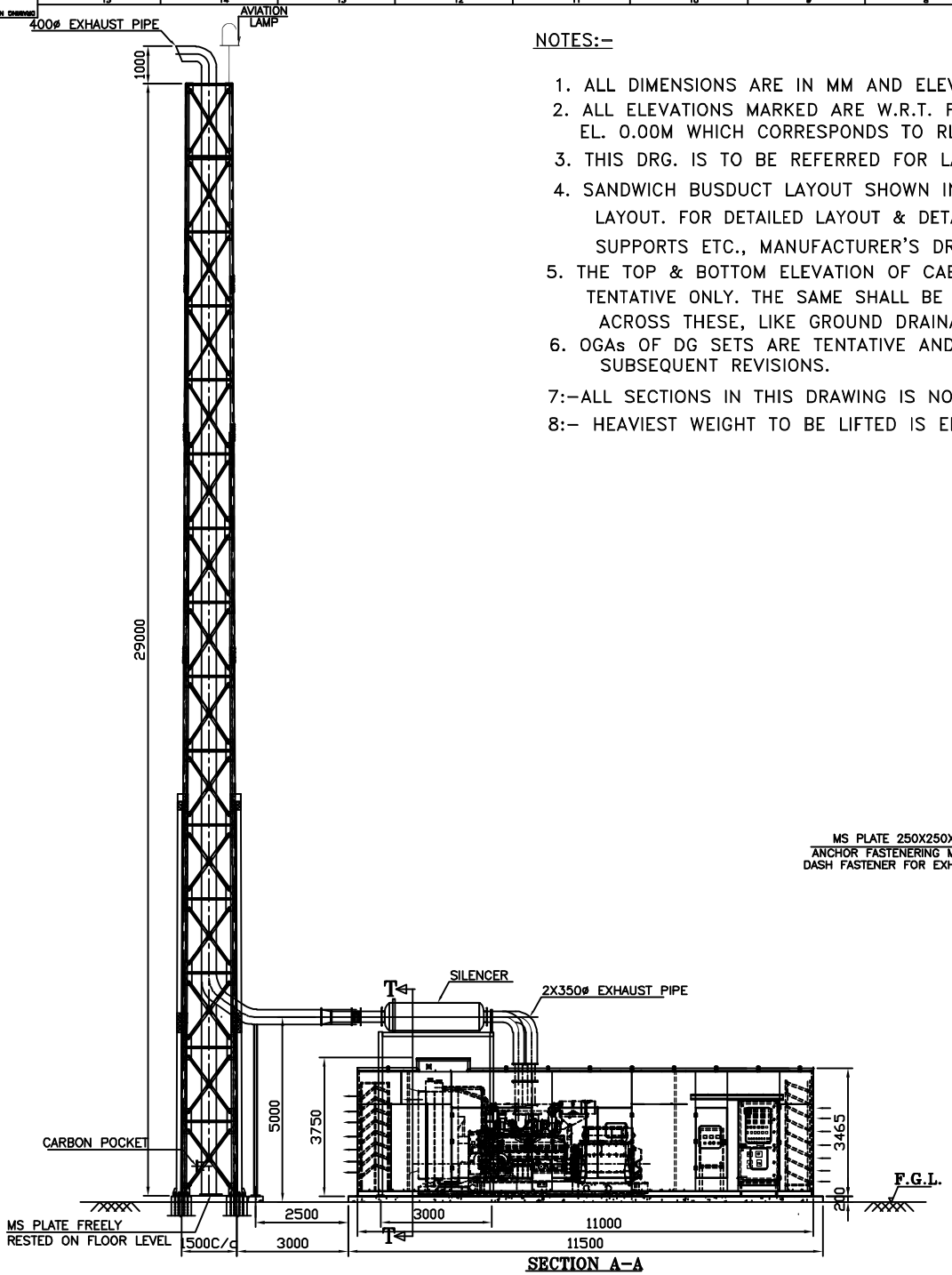
FORMAT SIZE A3

NOTES:-

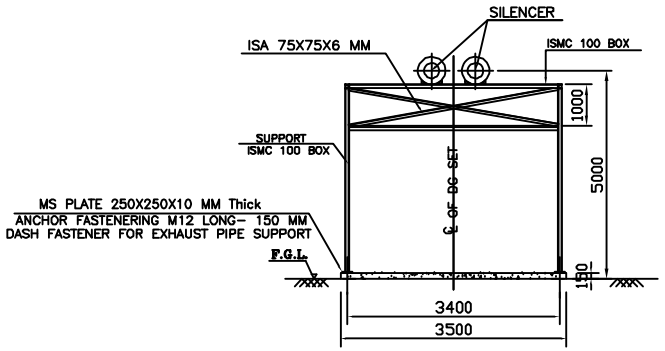
1. ALL DIMENSIONS ARE IN MM AND ELEVATIONS ARE IN METRES.
2. ALL ELEVATIONS MARKED ARE W.R.T. FINISHED FLOOR LEVEL (FFL) OF POWER HOUSE BUILDING GROUND FLOOR IS EL. 0.00M WHICH CORRESPONDS TO RL (+)194.5M.
3. THIS DRG. IS TO BE REFERRED FOR LAYOUT OF DG SETS AND ASSOCIATED EQUIPMENT.
4. SANDWICH BUSDUCT LAYOUT SHOWN IN THIS DRAWING IS FOR THE PURPOSE OF ESTABLISHING THE GENERAL ROUTING AND LAYOUT. FOR DETAILED LAYOUT & DETAILS OF CUTOUTS IN CLADDING/ WALL FOR BUSDUCT ENTRY, FOUNDATION SUPPORTS ETC., MANUFACTURER'S DRAWINGS SHALL BE APPLICABLE.
5. THE TOP & BOTTOM ELEVATION OF CABLE TRENCHES/ DUCT BANKS/ CABLE SLITS ETC. INDICATED IN DWG. ARE TENTATIVE ONLY. THE SAME SHALL BE FIXED BY CIVIL (PEM) BASED ON THE REQUIREMENT OF OTHER UTILITIES RUNNING ACROSS THESE, LIKE GROUND DRAINAGE OIL DRAIN PIPES, FIRE HYDRANT TRENCHES, X'MER TANKS, ROAD ETC.
6. OGAs OF DG SETS ARE TENTATIVE AND SHALL BE UPDATED AS PER MANUFACTURER DRAWINGS IN SUBSEQUENT REVISIONS.

7:-ALL SECTIONS IN THIS DRAWING IS NOT MADE TO SCALE.

8:- HEAVIEST WEIGHT TO BE LIFTED IS ENGINE OF 6 TONS



SECTION A-A



SECTION-T-T
SILENCER MOUNTING OF SUPPORT STRUCTURE

NTPC DRAWING NO.	9915-371-110-EIG-PVM-B-006
OWNER	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)
CONSULTANT	NTPC LIMITED (A GOVT. OF INDIA ENTERPRISE)
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2 X 660MW) (TURBINE GENERATOR & ASSOCIATED PACKAGES)
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI
TITLE	DG SETS-LAYOUT DRG & SECTIONAL DETAILS
DRAWING NO.	IS-3-DG-750-800-A010
JOB NO.	IS-1-19-2024
STATUS	CONTRACT
SCALE	SCALE VARIES
SHEET	4 OF 4
REV NO	00

NTPC SAFETY RULES FOR CONSTRUCTION AND ERECTION OF POWER PLANTS

NTPC SAFETY RULES

FOR CONSTRUCTION AND ERECTION OF POWER PLANTS

INTRODUCTION:

NTPC Limited is a Maharatna organization taking lead in realizing the power dreams of the Nation with a vision "To be one of the World's largest and best power utilities, Powering India's growth". Safety is one of the prime concerns of NTPC and it always strives towards accident free construction, erection, commissioning, operation and maintenance of its power projects. In this process, NTPC has already formulated Safety policy and guidelines for smooth execution of all its project activities.

In order to strengthen the existing Safety Rules for Construction and Erection and thereby curbing the chances of accidents in Construction & Erection works at various projects of NTPC, the existing safety rules have been revised for strict implementation. These Safety Rules lay down the safety requirements for safe execution of project activities, responsibilities of the contracting agencies, and all concerned involved in Construction and Erection.

A. RESPONSIBILITIES OF CONTRACTORS FOR IMPLEMENTATION OF SAFETY RULES:

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The contractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

FOR GREENFIELD PROJECTS:

(a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
(b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

FOR EXPANSION, MODIFICATION, ALTERATION AND, OR CONSTRUCTION ACTIVITY WITHIN AN EXISTING PLANT OPERATING AS PER APPROVED SITE PLAN UNDER THE FACTORIES ACT;

(a) Factories Act, 1948,
(b) Factories Rules, as adopted by the various State Governments
(c) BOCW Act
(d) BOCW Rules

The contractor is also required to ensure compliance with all the relevant Acts/Rules in addition to above.

It shall be incumbent on the contractor to ensure that the requirements of safety, statutory or otherwise specified, are fully met. Thus the onus of implementation of the norms so prescribed shall squarely rest with the contractor concerned or, on his behalf, his sub-contractor or any other agency deployed by him, indemnifying NTPC from all the liabilities that may arise out of any failure to comply with the above mentioned Acts/Rules or any contravention thereof by the contractor or any other sub-agency on his behalf.

Safety cannot be ensured solely through Rules and Regulations or Codes. It is the responsibility of the Contracting Agency to ensure that basic safety principles are incorporated in the planning stage of their mobilization, execution, installation of machines, equipment, storage, etc., and initiate and maintain *safety programs*. It is desirable to have a planned programme and secure adequate cooperation of senior management, EICs, sub-contracting agencies, supervisory personnel and workers involved to ensure the implementation of the provisions of these Rules in true spirit so as to achieve the ultimate goal of *accident prevention*.

It shall also be the responsibility of the contracting agency to provide amenities and safety requirements on each construction job in order to reduce or to eliminate hazards of construction activities and also to provided necessary *first aid* facilities as well as Ambulance van (in case of major agencies) for prompt transportation of injured persons to a physician or hospital.

It is also mandated that the authorized representative of NTPC, namely, the Engineer-in-charge, may, at his convenience, exercise such superintendence, supervision and, or control as may be deemed necessary, but this shall not absolve the contractor of his basic responsibility for strict compliance with the norms, standards and, or legal provisions as applicable under the Factories Act/Rules and the Building and other construction (regulation of employment and conditions of service) Act/Rules.

Section wise checklist of provisions of BOCW Act/Rules is given hereunder for ready reference of the contractor. (This list has been prepared in chronological order with primary importance to **S**ection of Act and secondary importance to **R**ules)
S - Refers relevant **S**ections in BOCWA
R - Refers relevant **R**ules in BOCWR

Sl. No.	ITEMS	RELEVANT SECTIONS / RULES IN BOCWA AND BOCWR AND RBOCWR
1	Registration of establishment	S – 7, R – 23 to 27
2.	Display of registration certification at workplace	R – 26 (5)
3.	Hours of work	S – 28 R – 234 to 237
4.	Register of overtime	S – 28; S – 29 R – 241(1) Form XXII
5.	Weekly rest and payment at rest	R – 235
6.	Night shift	R – 236
7.	Maintenance of workers registers and records	S – 30 R – 238
8.	Notice of commencement and completion	S – 46 R – 239
9.	Register of persons employed as building workers	R – 240
10.	Muster roll and wages register	R – 241(1) (a); Form XVI and XVII
11.	Payment of wages	R – 248
12.	Display of notice of wages regarding	R – 249
13.	Register of damage or loss	R – 241(1)(a); Form XIX, XX, XXI
14.	Issue of wages book	R – 241(2)(a); Form XXIII
15.	Service certificate for each workers	R – 241(2)(b); Form XXIV
16.	Display an abstract of BOCWA and BOCWR	R – 241(5)
17.	Annual return	R – 242; Form XXV
18.	Drinking water	S – 32
19.	Latrines and Urinals	S – 33 R - 243
20.	Accommodation	S – 34
21.	Creches	S – 35
22.	First-aid boxes	S – 36 R – 231 and Schedule III
23.	Canteens	S – 37 R – 244
24.	Food stuff and other items served in the canteens	R – 245
25.	Supply of tea and snacks in work place	R – 246
26.	Food charges on no loss no profit basis	R - 247
27.	Delhi BOCW welfare Board Rules	R – 250 to 296
28.	Safety committee	S – 38 R – 208

29.	Safety officer	S – 38 R – 209 and Schedule VII
30.	Reporting of accidents and dangerous occurrences	S – 39,R – 210
31.	Procedure for inquiry in to the causes of accidents	R – 211
32.	Responsibility of employer	S - 44 R – 5
33.	Responsibility of Architects, Project engineer and Designers	R – 6
34.	Responsibility of workmen	R – 8
35.	Responsibility for payment of wages and compensation	S – 45
36.	Penalties and Procedures	S – 47; S – 55
37.	Excessive noise, vibration etc.	R – 34
38.	Fire Protection	R – 35
39.	Emergency action plan	R – 36
40.	Fencing of motors	R – 37
41.	Lifting of carrying of excessive weight	R – 38
42.	Health, Safety and Environmental Policy	R – 39
43.	Dangerous and Harmful Environment	R – 40
44.	Overhead protection	R – 41
45.	Slipping, Tripping, Cutting, Drowning and Falling Hazards	R – 42
46.	Dust, Gases, Fumes, etc.	R – 43
47.	Corrosive substance	R – 49
48.	Eye Protection	R – 45
49.	Head Protection and other protection apparel	R – 46; R – 54
50.	Electrical Hazards	R – 47
51.	Vehicular traffic	R – 48
52.	Stability of structure	R – 49
53.	Illumination	R – 50; R – 124
54.	Stacking of materials	R – 51
55.	Disposal of debris	R – 52
56.	Numbering and marking of floors	R – 53
57.	Lifting appliances and gears	R – 55 to 81
58.	Runways and Ramps	R – 82 to 85
59.	Working on or adjacent to water	R – 86 & 87

60.	Transport and earthmoving equipment's	R – 88 to 95
61.	Concrete work	R – 96 to 107
62.	Demolition	R – 108 to 118
63.	Excavation and Tunneling works	R – 119 to 168
64.	Ventilation	R – 153
65.	Construction, repair and maintenance of step roof	R – 169 to 171
66.	Ladders and Step ladders	R – 172 to 174
67.	Catch platform and hoardings, chutes, safety belts and nets	R – 175 to 180
68.	Structural frame and formworks	R – 181 to 185
69.	Stacking and unstacking	R – 186 & 187
70.	Scaffold	R – 188 to 205
71.	Cofferdams and Caissons	R – 206 to 211
72.	Explosives	R – 212 & 213
73.	Piling	R – 214 to 222
74.	Medical Examination for building and other construction worker, Crane operator an Transport vehicle drivers	R – 81; R – 223(a)(iii) and Schedule
75.	Medical examination for occupational health hazards	R – 233(a)(iv)
76.	Charging of workers for Medical Examination	R – 223(b)
77.	Occupational health centres and Medical officers	R – 225 and Schedule X & XI
78.	Ambulance van & room	R – 226 & 227 and Schedule IV & V
79.	Stretchers	R – 228
80.	Occupational health service for building workers	R – 229
81.	Medical examination for occupational health hazards	R – 223(a)(iv)
82.	Emergency care services and emergency treatment	R – 232
83.	Panel of experts and agencies	Central Rule 250
84.	Power of inspectors	Central rule 251

B. RESPONSIBILITIES AND DUTIES OF WORKERS

(a) It shall be the responsibility of the worker to comply with the requirements of safety as laid down for him and the group of workers to which he belongs and fully cooperate in the discharge of the responsibility that has been assigned to the contractor.
(b) If he discovers any defects in the lifting appliance, lifting gear, lifting device or those concerning any transport equipment or other construction equipment or tools as well as the physical work conditions, he will report such defects promptly to his employer or NTPC Engineer or other person in authority;
(c) No building worker shall, unless duly authorized or in case of absolute necessity, remove or interfere with any fencing, guards, gangways, gear, ladder, hatch covering, life saving appliances, lighting or other things whatsoever required and provided for safety and health. If any of the aforesaid things is removed, the persons engaged in the work shall restore such thing at the end of the period during which its removal was necessary;
(d) Every worker shall use only means of access provided in accordance with the approved norms and no person shall authorize or order another to use such means of access or method other than those approved;
(e) Workers shall use such means of access and egress for going to and exiting from the workplace as provided.

SECTION - I
SAFETY MANAGEMENT

1.0 SAFETY MANUAL AND SAFETY POLICY:

1.1 The Safety policy of the contracting agency should reflect the commitment of the concerned agency towards safety and health of the workers specified for the particular site.

1.2 The Contractor shall have Safety Plan detailing the safety norms evolved through Safety Policy and Job Safety Analysis (JSA) or Hazard Identification & Risk Assessment (HIRA) of all package activities and constitute a Safety management program. Contracts shall also ensure POWRA (point of work risk assessment) before start of any activity.

1.3 The safety management programme in the form of Safety Manual shall give details of provisions proposed by the agency w.r.t. Job Safety Analysis (JSA) or Hazard Identification and Risk Assessment (HIRA) to ensure safety of the employees and elimination of health hazards. The Safety Manual including safety policy duly signed by the head/senior executive of the agency shall be submitted to the concerned Engineer-Incharge(EIC), NTPC before start of their project activities at site.

1.4 Each contracting agency shall have facilities for conducting the above safety management programme, commensurate with magnitude of the work under contract.

2.0 APPOINTMENT OF SAFETY OFFICER/SAFETY SUPERVISOR:

2.1 Each contracting Agency shall provide a sufficient number of qualified, suitable and experienced persons to manage all safety related matter on Site relating to the works. Irrespective of manpower employed by the agency whether temporary, casual, probationer, regular or permanent or on contract, Agency shall deploy a qualified Safety Officer/executive, responsible for carrying out the safety management programme before start of the work.

2.2 The safety officer shall create an organization, commensurate with the project activities, consisting of other staff as required for suitable deployment.

2.3 The schedule of requirement of safety personnel is given below.

No. of Workers	No. of Safety Supervisors	No. of Safety Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5
Above 4000	18 + One additional supervisor up to every additional 250 workers	5 + one safety officer up to addition 1000 workers

2.4 The qualification and experience of the safety personnel should meet the following criteria.

a) Safety Supervisor: (i) Possesses recognized degree in any branch of Engineering. OR
(ii) Diploma in any branch of Engineering with at least one year construction experience.

b) Safety Officer/Safety Executive: Qualification as given under BOCW Act/rules and minimum experience of three years.

2.5 In case contractor fails to employ the required safety professionals, the department may at the cost and risk of the contractor deploy additional/required safety professionals. The cost incurred towards this shall be deducted from contractor's bill at following the rates or actual whichever is higher.

l. Safety Engineer	Rs. 1500/day.
2. Safety Supervisor	Rs. 1000/day.

3.0 MEETING FOR SAFETY AFTER AWARD OF THE CONTRACT:

Representatives of contracting agency along with safety Officer/executive shall meet the concerned EIC of the particular activity prior to start of construction activities for the purpose of discussing safety standards and requirements applicable to the work under contract. The person representing the agency should be a responsible person for all their site activities.

4.0 PERSONAL PROTECTIVE *EQUIPMENT:*

4.1 The contracting agency should ensure sufficient inventory of personal protective equipment (PPEs) prior to initial mobilization as specified in the Bidding Documents. After identifying the need of the required PPEs for various activities performed at the site, an additional inventory of approx. 20% of required PPEs should be maintain during the execution of the work. A PPE plan shall be prepared which gives fair idea regarding issue of PPEs to various personnel as per the following 'PPE Selection Matrix'.

4.2 **Mandatory PPEs:** Wearing of Safety Helmet, Safety Shoes and reflective jacket is mandatory for all work at site and it should be ensured that all employees and project visiting personnel shall invariably wear safety helmet, safety shoes & reflective jacket.

PPE Matrix (apart from mandatory PPEs, i.e., Safety Helmet & Safety Shoes)

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space

Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLFBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	
Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP/ EM	CA	SAMH	-	

ABBREVIATIONS: *FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA : Online breathing apparatus*

4.3 The above-mentioned PPEs should be made available with contractor at site and issued to the concerned workers on the day of employment. All PPEs shall comply with ISI standards with valid test certificates.

4.4 At least two breathing apparatus sets (complying requirement as per IS: 10245) shall be provided at each site where excavation/tunneling works and Welding/ Cutting operations in confined areas are being carried out, to rescue the victims under exposure to harmful gases/vapors, if any.

5.0 SAFETY COMMITTEE:

5.1 *Safety committee* shall be formed within each contracting agency comprising of worker representatives with equal no. of management representatives as per the provisions of BOCW Act/rules. This committee in each agency shall meet at least once in every month. The safety officer of the concerned agency shall coordinate these meetings. NTPC Safety officer shall be special invitee for Safety Committee meetings. The safety committee functioning shall be in line with the provisions of BOCW Act/Rules.

5.2 Apart from the above, each agency shall organize safety meetings every day before start of day's work to educate & motivate the workers about the necessity of safety. Case study of accident/ incident can be shared in these meetings.

5.3 The contractor shall also regularly organize safety meetings for all job supervisors/foremen.

5.4 Weekly meeting with agencies' Safety Officers to be organized by safety department of NTPC and minutes to be recorded, circulated and compliance status to be checked on regular basis.

6.0 SAFETY MESSAGE PROPAGATION:

6.1 Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely. Minimum one safety message board/hoarding of appropriate size for every 10 workers to be provided and maintained by the concerned agency.

6.2 Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.

6.3 Safety suggestion boxes shall be kept at each contractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.

7. COMPETENCY OF EMPLOYEES:

7.1 Throughout the course of the contract, persons employed by agency shall be physically fit, qualified/experienced to perform their assigned duties/ jobs.

7.2 Employees shall not, knowingly be permitted to work in a manner that their ability or alertness is so impaired because of fatigue, illness or any other reason, that it may expose them and or others to injury.

7.3 No worker, vehicle operator shall be less than 18 years of age. And the vehicle operator shall have a valid license as per requirements of Motor Vehicle Act.

7.4 Contractor shall comply with all applicable state/central laws and codes related to employment of operators for Hoist, Shovel, Crane, Tractor, Bull-dozer, any other howling heavy equipment/vehicle.

8.0 SAFETY INDUCTION AND TRAINING :

8.1 Each worker deployed by the agency shall be given 2-days induction training which shall include the medical examination and instructions related to particular job, fire fighting, first-aid and reporting of accidents. All employees shall be given safety training as per BOCW Act/Rules.

8.2 The contracting agency shall also impart job specific skill based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge.

TRAINING MATRIX:

Name of topic	**Executives**	**Super visors**	**Skilled Workmen**	**Other Workers**
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y
Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators Y=Yes

9.0 ID PASS

9.1 CLIMS (Contract Labor Information Management System) will be the criterion for entering or gate pass system if implemented at site.

9.2 The contractor shall ensure that all personnel working at site having a photo Identity card before they are engaged for any work and properly mentioned details like validity, Category/designation and work area etc. This ID card should be issued only after ensuring their screening test, medical fitness and safety induction training. Id card gate pass shall be indicated with 3 nos. of offence marks. With each offence the gate pass of concerned workmen/ supervisor will be punched giving on the spot indication of persons indulging in unsafe actions.

9.3 Drinking of Alcoholic beverages is strictly prohibited. Employees under the influence of any intoxicants, even to the slightest degree, shall not be permitted to remain at work. Each contractor should maintain 'breath analyzer' to determine the intoxicated workers at site.

10 SAFETY AUDIT

10.1 Internal Safety Audit once in every six months by the contracting agency and external safety audit as once in a year by third party shall be conducted, with prior intimation to EIC and NTPC Safety Deptt. The external auditing agency should be reputed safety institution or a certified Safety Auditor under any statutory legislation. The audit report along with time bound action plan should be submitted to Engineer-in-charge and NTPC Safety Dept.

10.2 Apart from above, Electrical Safety Audit shall be conducted quarterly by a team comprising of Electrical engineer, Safety representative of contractor and NTPC Electrical Erection representative covering the following and submit the report to EIC.

i) Electrical incidents investigation findings and remedial measures implemented.

ii) Adequacy of power supply requirements

iii) Power distribution system in place

iv) Updated electrical single line diagram including the IP44 DBs arrangement.

v) Electrical protection devices – ELCBs, O/L protections etc.

vi) Earth or ground connection and earth pit maintenance details

vii) Education and training of electrical personnel undertaken

viii) Any other point appropriate to the site conditions.

11. SAFETY BUDGET

Every contracting agency should clearly estimate and allocate a separate budget head for safety requirements every year and make the safety activity plan for the year and submit to NTPC EIC & Head of Safety. Budget allocations should be practically adequate to the site safety requirements and the details shall be intimated to the concerned EIC and safety deptt. before start of the work under the contract and subsequently, every year by 15th of April. Engineer-in Charge in consultation with Head of Safety shall review and monitor the effective utilization of allocated budget for safety related activities by the Contractor.

12. REPORTING AND INVESTIGATION OF ACCIDENTS AND DANGEROUS OCCURRENCES:

12.1 **Reporting of accidents:** Notice of any accident (the prescribed format is annexed to the manual) to a worker at the building or construction site that

(a) Causes loss of life; or

(b) Disables a worker from working for a period of **48 hours** or more immediately following the accident;

Shall forthwith be sent by Telegram, Telephone, Fax, Email or similar other means including special Messenger within **four hours** in case of **fatal accidents** and **72 hours** in case of **other accidents**, besides the Engineer-in-charge, to:

I. The Regional Labour Commissioner (Central);

II. The Board with which the worker involved was registered as a beneficiary;

III. Director General of Building and other construction (regulation of employment and conditions of service) Act/Rules; and

IV. The next of kin or other relative of the worker involved in the accident;

12.2 Further, notice of accident shall be sent in respect of an accident which

(a) Causes loss of life; or

(b) Disables the injured worker from work for more that 10 days to

(1) The Officer-in-charge of the nearest Police Station;

(2) The District Magistrate or, if the District Magistrate by order so desires, to

(3) The Sub-Divisional Magistrate;

12.3 Where any accident causing **disablement that subsequently results in death**, notice thereof in writing of such death, shall be sent the Authorities mentioned above within **72 hours** of such death.

12.4 In case of an accident causing minor injury, first-aid shall be administered and that resulting in disability of **48 hours or more**, the injured worker shall be given first-aid and immediately transferred to a Hospital or other place for medical treatment.

12.5 All near-miss accidents shall be reported to NTPC Engineer In-charge and Safety Officer as per prescribed format.

12.6 **Reporting of dangerous occurrences:** The following classes of dangerous occurrences shall be reported to the Inspector having jurisdiction, whether or not any disablement or death caused to the worker, namely:

(a) Collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage or failure of rope, chain or loose gears; or overturning of cranes used in construction work;

(b) Falling of objects from height;

(c) Collapse or subsidence of soil, any wall, floor, gallery, roof or any other part of any structure, platform, staging, scaffolding or means of access including formwork;

(d) Contract work, excavation, collapse of transmission;

(e) Explosion of receiver or vessel used for storage at pa pressure than atmospheric pressure, of any gases or any liquid or solid used as building material;

(f) Fire and explosion causing damage to any place on construction site where building workers are employed;
(g) Spillage or leakage of any hazardous substance and damage to their container;
(h) Collapse, capsizing, toppling or collision of transport equipment;
(i) Leakage or release of harmful toxic gases at the construction site;
(j) In case of failure of a lifting appliance, loose gear, hoist or building and other construction work, machinery and transport equipment at a construction site, such appliances, gear, hoist, machinery or equipment and the site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Authorities;

12.7 Every notice given for fatal accidents shall be followed by a written report to the concerned Statutory Authorities and the Engineer In-charge in the specified Form annexed as Schedule, under acknowledgement.

12.8 Incident / injury statistics shall be maintained by all agencies cause wise.

12.9 Investigation of accidents and dangerous occurrences

Besides reporting, it shall be the responsibility of the contractor to constitute a team (members as per the gravity of the incident) of responsible person to thoroughly investigate all incidents involving near-miss accidents, lost-time and reportable accidents and dangerous occurrences with a view to finding out the causative factor, taking remedial measures and fixing responsibility, and make a copy of the investigation report along with action-plan, specifying a definite time-frame for implementation of the findings, available to the Engineer in-charge forthwith.

13. MEDICAL AND FIRST AID AMENITIES:

13.1 It is the responsibility of each contracting agency to ensure the availability of suitable arrangements at their work site for rendering prompt and efficient First aid to injured persons.

13.2 Arrange one trained and certified first aid for every twenty workers in each shift.

13.3 Ambulance with proper equipment for prompt transportation of the injured persons to a physician or a hospital shall be provided before start of the work in cases where 500 or more than 500 workers are employed. For smaller contracts, where less than 500 workers are employed, Contractor shall have a tie-up with suitable Agency for providing Ambulance with proper equipment for prompt transportation of the injured persons to a physician or a hospital in case of an Accident / Emergency. Further, Contractor shall submit a proof of the same to EIC/Safety Officer of NTPC.

13.4 Deploy one full time construction medical officer (qualification as per Schedule XI of BOCW Central Rules -1998) for cases where 500 or more workers are employed (upto one thousand workers) and one additional construction medical officer for additional one thousand workers or part thereof. For smaller contracts, where less than 500 workers are employed, Contractor shall have a tie-up with suitable Hospital / Nursing home in the vicinity of the

Project/Site where work is being executed, for providing adequate medical treatment by qualified medical officers and nursing staff, as and when required. Further, Contractor shall submit a proof of the same to EIC/Safety Officer of NTPC.

Notwithstanding anything stated above, Contractor/Agency shall strictly comply with the requirements of relevant BOCW Act/ BOCW Rules/ Factory Act/Factory Rules/ any other statutory Act/Rules/Law with regards to providing suitable medical facilities to the workers.

In case contractor fails to employ the required construction medical officer alongwith Additional staff, corresponding payment for the same shall not be made and/or necessary action as per provisions of the Bidding documents shall be taken by NTPC.

13.5 Additional staff including one nurse, one dresser-cum compounder, one sweeper-cum-ward boy with each construction medical officer for full working hours

13.6 The Telephone nos. of Medical officer, Hospital(s) or ambulance shall also be conspicuously displayed at each work site.

13.7 First-aid kits as approved by medical officer shall be provided at accessible points in the ratio of at least one kit for every 50 employees.

13.8 **Health Management:** The site manager shall implement health examinations for the working personnel on a regular basis.

Types of health examination	Target	Frequency
General health examination	All workers	Annual
Occupational health examination (Audiometric, PFT, Vision etc.)	Worker engaging in noise, dust, vibration, harmful light generating work	Annual
Occupational health examination (Vision)	Personnel involved in operation of Cranes, heavy vehicles	Annual
Occupational health examination (Vertigo/Height pass)	Workers engaged at Height Works	At the time of induction training and every year

14. TESTING & EXAMINATION OF LIFTING, TOOLS, TACKLES, PRESSURE VESSELS AND OTHER EQUIPMENT:

14.1 All the lifting equipment, tools, tackles, pressure vessels etc. shall be tested & examined as per BOCW or Factories Act and rules made there under.

14.2 The records & certificates of such testing & examination shall be maintained and readily available for reference to statutory authorities/engineer-in-charge.

14.3 Proper color coding system should be maintained and marking should be done accordingly on all lifting tackles.

14.4 Regular testing of ELCBs and RCCBs by competent electrician must be ensured by agencies and record should be maintained.

15. EMERGENCY MANAGEMENT PLAN

15.1 The contractor shall ensure that an Emergency Management Plan is prepared to deal with emergencies arising out of:

a. Fire and explosion;
b. Collapse of lifting appliances and transport equipment;
c. Collapse of building, sheds or structure etc.;
d. Gas leakage or spillage of dangerous goods or chemicals;
e. Drowning of workers, sinking vessels, and
f. Landslides getting workers buried; floods, storms and other natural calamities.

15.2 While arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.

15.3 It is also required that there is a tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.

15.4 It shall be the responsibility of the contractor to keep the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. Prompt communication to NTPC, telephonically initially and followed by a written report, shall be made by the contractor.

16. ENFORCEMENT OF SAFETY CODE, SAFETY RULES & REGULATIONS:

The Engineer-In charge shall ensure that the contractor is exercising at all times, reasonable and proper precautions for the safety of people at works and complying with the provisions of current safety rules and laws according to safety code and relevant statutes of state/central governments. In case of negligence or default, the agency shall be penalized suitably as per penal provisions of NTPC Safety Rules.

17. WORK PERMIT SYSTEM

17.1 The Contractor shall implement Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken. Work Permits form an essential part of safe systems of work for many construction activities. They start the work

only after safe procedures have been defined and clearance taken from respective NTPC EICs. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

17.2 Examples of high-risk activities include but are not limited to:

i) Entry into confined spaces
ii) Cutting & welding
iii) Working at Height along with
checklist iv) Working on electrical
equipment
v) Heavy lifting operations
vi) Removal of grating/ Handrail / floor opening
vii) Material Shifting

The copies of recommended formats for reference is given in annexure-IV.

17.3 The permit-to-work system should be fully documented, laying down:

i) How the system works
ii)The jobs it is to be used for;
iii) The responsibilities and training of those involved; and
iv) How to check its operation;

17.4 A Work Permit authorization form shall be completed with the maximum duration period not exceeding 12 hours.

17.5 A copy of each Permit to Work (PTW) shall be displayed near to work are (on PTW Display board) in close proximity to the actual works location to which it applies.

18. ACCESS TO AND FROM THE WORKPLACE

18.1 Safe, clean, well lit, unencumbered access and egress to and from work areas shall be maintained at all times in normal operating conditions.

18.2 The number and location of accesses and egresses from and to the workplace shall be adapted to the number of people likely to be present at any time, and therefore to evacuate from the workplace in case of emergency.

18.3 If access and egress to work areas are restricted due to operational conditions (e.g. access restricted due to pressure testing, etc.), alternative access and egress ways must be implemented, so far as is reasonably practicable. If this is not reasonably practicable, all concerned organizations and persons must be informed of the access restrictions, and work scheduling must be adapted in consequence.

18.4 Temporary access to height or into ground openings shall be of purpose made material such as scaffolds, stair cases/towers and ramps, which incorporate guardrails .

19. INTERFERENCE WITH MOVING VEHICLES AND PEDESTRIANS

19.1 The circulation of vehicles and pedestrians must be segregated by establishing restricted areas, one way routes where possible, pedestrian crossing zones and designated parking areas.

19.2 The appropriate measures must be implemented in order to prevent collision between pedestrians and vehicles at pedestrian crossings. This may include, but shall not be limited to:
- Mirrors;
- Lighting;
- Speed bumps before the crossing point.

19.3 Vehicle and pedestrian ways shall be physically separated with Hard-barriers, so far as is reasonably practicable, and be indicated with signs.

19.4 When it is not reasonably practical to implement a physical segregation, pedestrians must maintain safety distance of at least 2 meters from moving/operating vehicles at all times.

19.5 Traffic rules must be made visible through signage and traffic stops, consistent with those used on public

19.6 Roads as per road safety requirement.

19.7 All pedestrians on Project sites must wear high-visibility garments.

19.8 Pedestrians (including banksmen) must wear high-visibility garments in all areas where trucks and other vehicles (forklifts, cranes, etc.) maneuver. These areas must be clearly signaled / marked (floor painting, Hard-barriers, signs, etc.).Additional points:

19.9 Competent banksmen must be used for operations involving reversing or maneuvering where space or view is restricted.

19.10 Drivers must only operate vehicles they are competent to drive and must follow the established traffic routes and comply with all site rules.

19.11 The maximum driving speed on site is 15 km per hour.

19.12 Drivers and passengers must not get on or off moving vehicles.

19.13 When driving a forklift, forks must be lowered, the mast tilted back.

19.14 Smoking, eating, drinking, using a mobile phone or using earbuds or headphones when driving a vehicle is strictly prohibited.

19.15 When the vehicle is not in use, it must be ensured that:

- The engine is stopped and prevented from unauthorized use (e.g.: starter key removed), brake applied (and with wheels chocked for heavy vehicles);
- All raised parts are lowered to the ground or put in a safe position (cranes);
- It does not obstruct emergency exits, other routes, fire equipment or electricity panels.

20. HOUSEKEEPING

The contractor shall ensure that their work area is kept clean, tidy and free from debris generated by their activities. All debris/scrap should be stored in separate bins. The work areas must be cleaned on a daily basis and a full cleaning session of each area shall be conducted on a weekly basis. All equipment, materials and vehicles shall be stored in an orderly manner. Access to emergency equipment, exits, telephones, safety showers, eye wash stations, fire extinguishers, pull boxes, fire hoses, etc. shall not be blocked or otherwise disturbed, restricted or delayed.

21. STACKING AND STORAGE PRACTICE

Contractor Agency shall ensure stacked material is bonded on a stable and level footing capable of carrying the mass of the stack. Adequate clearances shall be provided between the sides of the stack and top to facilitate unimpeded access to service equipment like overhead wiring, cranes, forklifts and firefighting equipment, and hoses. Circular items shall be sufficiently choked with wedges not with odd bits of materials. Free-standing stacks of gunny bags and sacks such as Cement bags shall be stacked to prescribe safe stacking heights with layers formed for stable bonding, preventing slippage causing accidents. Stacking against walls shall not be permissible.

Contractor shall maintain the premises and surrounding areas in clean and clear manner with safe access and egress. There shall be sufficient and adequate storage racks, shelving, bins and pallets and material handling equipment to stack his construction materials such as Pipes, Structural and his construction enabling materials. Unwanted materials shall be promptly moved away for efficient material movement.

Any temporary store shed will be built in conformity with fire safety requirements. The stores must be provided with adequate lighting arrangement (Flame proof / intrinsically safe depending upon the Zone category) and must be equipped with sufficient fire extinguishing arrangement. “No Smoking” and other relevant signage must be displayed conspicuously at strategic locations and safety precautions must be strictly enforced.

All material should be kept at least 150mm above from the ground by providing wooden packing below. Maximum height of material stacking should not be greater than 3 meter. All loose material must be kept in wooden box or in sharp edge protected drum and material identification details to be displayed. Materials inside store room should be kept on scaffold rack.

Gas cylinder storage area must be 30m away from the hot work zone and separate storage facility must be available for empty and full cylinder with proper shed. Storage area must be design in a way that 6 meter distance between LPG/DA and oxygen maintained

22. CONFINED SPACES

All Confined Spaces belonging to Subcontractor shall be identified and clearly signed posted as a confined space forbidden to unauthorized Personnel at every entrance. A method for preventing entry must be established and maintained for all Confined Spaces. Physical prevention system (such as locks) is preferred.

Before commencing work in a Confined Space, the Subcontractor must obtain a Permit to Work from the relevant authority.

The following requirements shall be met at any time:

- Only competent and trained workers can participate to work in confined spaces (as a minimum as per local Law). A Confined Space Entry Log (or equivalent) must be used to identify the person inside the Confined Space at any time;
- Air Analysis tests must be carried out to determine if the Confined Space is oxygen deficient and/or contains flammable substances, toxic agents, carbon monoxide and/or harmful physical agents. The air shall be analyzed before starting work, during work and after work. Adequate ventilation must be provided;
- Working in the confined space without a watcher is strictly forbidden. An adequate means of communication is required and shall enable easy and clear communication:
- Between those inside the space,
- Between those inside the space and those outside,
- To summon help in case of emergency;
- Adequate emergency provisions must be in place. In particular, necessary rescue equipment must be ready, pre inspected and available. The arrangements need to be suitable and sufficient for the rescue of persons in the event of an emergency.

23. FIRE PROTECTION AND PREVENTION

Routine hot works should be described in the contractor Risk Control Plan .Non-routine hot works are submitted to daily hot works permits given by the relevant authority.

Full and unrestricted access to emergency exits, fire-fighting equipment, fire control and emergency vehicles shall be maintained at all times. The Subcontractor shall provide, install and maintain their own temporary fire protection against hazards they introduce to the Site (work areas, storage areas, and temporary facilities under their responsibilities).

Fire extinguishers shall be inspected at least annually by a certified person and visually inspected monthly and documented by the Contractor.

24. ELECTRICAL SAFETY

Personal authorization must be issued by Contractor Management (or formally designed delegates) likely to perform or supervise electrical works.

Without such an authorization validated by EIC, no Contractor's employee shall undertake electrical works.

No live work on high voltage or medium voltage is allowed. All high voltage and medium voltage electrical works must be performed on isolated equipment and only after verification of absence of voltage with suitable equipment. Low voltage and very low voltage live work is only allowed for measurement tests and checks of equipment. The below measures will be taken:

- Work practices must protect against direct or indirect body contact by means of tools or materials and be suitable for work conditions and the exposed voltage level
- A Lockout and Tagout procedure must be applied prior to commencing any electrical work. Prior to commencing works on isolated equipment, a verification of absence of voltage with suitable safety test equipment must be performed.
- Energized panels will remain locked with a specific key or tool whenever they are unattended and tagged with the signs and warnings indicating the presence of danger. If not reasonably practicable, a restricted area delimited with physical barriers and supported by warning signs must be implemented around the opened equipment.
- Only qualified electrical Contractor Personnel may enter substations and/or transformer vaults and only after being specifically authorized by NTPC EIC.
- All joints (Both terminal and intermediate) in cable should be made using lugs and joint area should be crimped using crimping tools.
- All temporary connection should be provided through 30mA ELCB/RCCB using 3 core double insulated cable and only 3 pin industrial plug top will be used for connection.
- Zero energy verification needs to be ensured before any electrical operation using only VAV before working on a live circuit which has been isolated
- Only industrial type DB to be used for connection and weather protection shed needs to be provided for every DB and shed height should not be less than man height.
- Double earthing protection must be provided for every electrical equipment and earthing value should be less than 1 Ohm
- Deployment of trained, experienced & licensed electrician as well as licensed electrical supervisor must be ensured at site as per Rule-45 of the Indian Electricity Rules, 1956 ;
- EIC May perform screening/ competency test for all contractor electrical professions i.e. electrical engineers and helpers. Selection/ rejection of the personnel who appear for the screening is sole discretion of EIC
- Electrical helper who will be engaged in helping the electrician/ engineer must have minimum ITI certificate to be eligible for working with him
- All PPE' s used while being involved in electrical work must be as per IS Standards available for electrical work

25. COMPRESSED GAS CYLINDERS

Gas cylinders shall be securely stored and transported, and identified and used in line with the safety Requirements as per Gas Cylinder Rules -2106.

Hose lines shall be adequately protected, inspected and tested for leaks in line with the safety Requirements. Flash back arrestor /NRV must be used at both ends of the hoses and all hose should be free from damage and fixed properly preferably using crimping clamps. Leakage test must be done before every use by soap solution and physical inspection of hose must be carried out regularly. Only trolley attached with wheel will be used for cylinder transportation in which cylinders must be kept secured with chain. Only Industrial type regulator fitted with two stage double dial pressure gauze is allowed to be used.

26. LIFTING OPERATIONS

The Contractor shall prepare a lifting plan, checked and submit for authorization by contractor's competent authorized persons prior to any lifting operation and formally communicated to all persons undertaking the work.

All persons preparing, issuing lifting plans and all persons involved in lifting operations must be subject to formal competence checks by the contractor to ensure necessary training, experience and qualification prior to commencing work. The Subcontractor must ensure that their nominated Lifting Leader has appropriate qualifications.

Contractor lifting plans include:

The lifting methodology, step by step

The risk analysis of the operation including consideration for weather conditions and work environments (e.g.: proximity of hazards and obstructions to the load, consideration for overturning, load integrity) where appropriate and consideration for simultaneous operations and the measures taken to avoid conflicting tasks in the lifting area

The identification of the designated lifting area, the fall zone and the control measures to prevent access such as barriers, signs, etc.

The description of the type, weight, size, shape and center of gravity of the load and the method used for slinging, attaching and detaching the load with the availability of approved lifting points on load when necessary

The list of the certified and inspected equipment and lifting accessories to be used

The composition of the team required to perform the task (crane driver, rigger, etc.) with the needed qualifications and description of their roles and responsibilities including the intended communication method

Any Heavy equipment (crane, winch machine, etc.) manufactured less than 15 years from the current year shall be only allowed to be used at our project Site's. Pre-safety Inspection of the equipment by safety deptt. shall be done before mobilizing the equipment at our project site.

The contractor must ensure that a competent operational leader is formally appointed to supervise each lifting operation. All lifting plans must clearly define the specific roles and responsibilities for each person involved (e.g.: crane drivers, lifting coordinators and riggers) and must be checked and issued prior to lifting operation. Clear communication channels must be formally established and maintained between everyone involved in a lift with only authorized person giving instruction to the operator.

Special permission needs to be taken from NTPC EIC for tandem lifting and for any non-routine lifting operations must strictly adhere to the guidelines described in corresponding Standard / Procedures / Directive.

No employee of the contractor shall be positioned under a suspended load or between a suspended load and fixed objects.

All lifting equipment and accessories must have valid manufacturers certificates or thorough examination records and be uniquely identified, marked with the safe working load, listed in a register and subject to formal regular inspection as per EHS requirements and shall have valid certificates from a competent authority. Inspection before use by the operator is mandatory. All lifting hooks must have latch. All cranes shall be fitted with Automatic Safe Load Indicator (ASLI) and Anemo Meter.

The contractor shall operate and maintain cranes and hoisting equipment in accordance with manufacturers' specifications and limitations and the safety Requirements. All defective, non-inspected or unidentified (safe working load / identification number) lifting equipment or accessories must be either removed from site or physically prevented from use.

27. LOCKOUT TAGOUT ("LOTO")

Prior to performing work on Machines or Equipment, the Subcontractor shall ensure that all energy sources are isolated and verify the absence of residual energy (e.g.: by using specific voltage detecting device for electricity).

At any time, the contractor shall follow the Site-specific LOTO and Permit to Work rules. The contractor must ensure that all of their affected Subcontractor Personnel receive the necessary training. Lockout/ Tagout must be implemented before servicing and maintenance is performed on Machines and Equipment, which could unexpectedly start-up, become energized, or release stored energy exposing persons to a risk of injury, unless the works undertaken are performed using alternative measures that provide effective protection.

Absence of residual energy must be verified using the suitable equipment or process adapted to the machine and the kind of energy to be checked before start of work. *The contractor must procure suitable VAV instrument for verification of absence of voltage before implementing LOTO all by themselves.*

When the contractor is in charge of LOTO, each authorized person must be issued with an individual lock with a unique key. The contractor shall secure areas where energy sources have been de energized, so as to prevent the access of unauthorized personnel and erect suitable signs. All affected Personnel shall be notified.

Once an item of electrical equipment has been energized, an item of mechanical plant and/or System has been erected and released for Commissioning, no work will be allowed on such item of Equipment or System unless a valid Permit to Work (PTW) has been obtained from the relevant authority.

28. MONTHLY SAFETY REPORT

Agency has to submit the monthly safety activity report in the form of Lead-Lag indictor to NTPC Safety Deptt. Sample format attached as annexure –IV.

29. In case the Contractor doesn't adhere to any of the provisions of the NTPC Safety Rules for Construction and Erection of Power Plants, corresponding payment for the provisions not adhered, shall not be made and/or necessary action as per provisions of the Bidding documents shall be taken by NTPC.

SECTION-II

1. Safety at workplace and equipment

1.0 GENERAL PROVISIONS:

1.1. Housekeeping:

a. The contractor shall be primarily responsible for maintaining Good housekeeping and safety standards in the workplace;
b. Loose materials that are not required for use shall not be placed or left behind so dangerously as to obstruct workplaces or passageways;
c. All projecting nails shall be removed or bent to prevent injury;
d. Equipment, tools and small objects shall not be left lying unattended or unsecured from where they could fall or cause a person to trip;
e. Scrap, waste or rubbish shall not be allowed to accumulate in the site as these combustibles can create serious fire hazards and affect safe working;
f. Workplaces and passageways that become slippery owing to spillage of oil or other causes shall be cleaned up or strewn with sand, ash or the like;
g. Portable equipment shall be returned after use to their designated storage place.

1.2. Means of access and egress shall consist of

a. Adequate and safe means of access and egress shall be provided in all workplaces;
b. The means of access and egress shall be maintained in a safe condition;

1.3 Lighting and ventilation

a. All practical measures shall be taken to prevent smoke, fumes etc. from obscuring any workplace or equipment at which any worker is engaged;
b. Adequate and suitable artificial lighting shall be provided where natural lighting is not sufficient as per IS 3646 (Part II). The artificial lighting so provided shall not cause any incidental any danger, including that of producing glare or disturbing shadows;
c. To prevent danger to health from air contamination by dust generated during grinding, cleaning, spraying or manipulation of materials as also to provide protection against dangerous gases, fumes, vapours, mist, etc. effective arrangements shall be made for ventilation;
d. Workers shall be provided with suitable respiratory protective equipment, if it is not technically possible to have uncontaminated air. To this end, a study by a competent person shall be made to decide on the due protection. Sufficient illumination at all times for maintaining safe working conditions shall be provided where building workers are required to work or pass, and for passageways, stairways and landings such illuminations shall not be less a than 0.5 foot candles at the floor level;
e. Where natural lighting is not adequate to prevent danger, adequate and suitable lighting shall be provided as per IS: 3646 – Part II;
f. Artificial lighting shall not cause any danger due to a brightness greater than 10 foot candles per square inch, except where the angle of inclination from the eye to the source or the part pf the fitting as the case may be exceeds 20^0, including that of producing glare or disturbing shadows;
g. Where necessary to prevent danger to health from air contamination by dust from the grinding, cleaning, spraying, or manipulating of materials or objects, arrangements shall be made to limit the concentration of the pollutants by thorough ventilation, and dust generated due to movement of earthmoving machinery and other construction equipment, by spray of water in the area from time to time;
h. Adequate ventilation by the circulation of fresh air shall be maintained in such places where the concentration of pollutants is likely to affect the health of the workers;

i. Special care shall be taken to ventilate the workplace where gas cutting, welding or other operations involving generation of dangerous fumes, vapours, mists, gases etc is likely;
j. Where it is technically not possible to eliminate dust or noxious or harmful fumes or gases sufficiently to prevent injury to the health of the workers, the contractor shall provide suitable respiratory equipment like dust mask or gas/fume mask or breathing apparatus or other suitable respiratory equipment.

1.4. Dangerous and harmful environment:

a. When an internal combustion engine exhausts into confined space or excavation or tunnel or any other workplace where neither natural ventilation nor artificial ventilation system is adequate to keep the carbon monoxide content of the atmosphere below fifty parts per million, adequate and suitable measures shall be taken at such workplace in order to avoid exposure of building workers to health hazards;

b. No building worker shall be allowed to enter any confined space or tank or trench or excavation wherein there is given off any dust fumes or other impurities of such nature and to such extent as is likely to be injurious or offensive to the building worker or in which explosives, poisonous, noxious or gaseous material or other harmful articles have been carried or stored or in which dry ice has been used as a refrigerant, or which has been fumigated or in which there is a possibility of oxygen deficiency, unless all practical steps have been taken to remove such dust, fumes or other impurities and dangers which may be present and to prevent any further ingress thereof, from such workplace or tank or trench or excavation;

c. No worker shall be allowed to enter any such space unless a responsible person has certified it safe and fit for the entry of such building workers.

1.5. Fumes/gases due to Welding and gas-cutting operations: When welding or cutting operations are carried out in a confined space:

a. Adequate ventilation, by means of exhaust fans or forced draught, as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be circulated by means of air compressors to dilute the contaminant within permissible limits;

b. Workers shall take necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space;

c. Welding or cutting operations on any container that has held explosives or where inflammable gases may have been generated, shall be undertaken after the container has been thoroughly cleaned by steam or other effective means; and

d. Gas-test shall be carried out ensure that the confined space is completely free from combustible gases and vapours.

1.6. Dust, gases, fumes

a. Concentration of dust, gases or fumes shall be prevented by providing suitable means to control their concentration within the permissible limit so that they may not cause injury or create health hazard to a building worker;

b. For protection against such hazardous substances, besides efficient and effective means of control, personal protective equipment like dust masks, breathing apparatus, other respiratory appliances, goggles, as the case may be, shall be provided.

1.7. Excessive noise:

a. Adequate measures shall be taken against the harmful effects of an excessive noise;
b. Use of earplugs/muffs and anti-vibration gloves shall be ensured to protect the workers from the impact of exposure to such dangers;
c. The noise level in no case shall exceed as prescribed in the concerned Rules and exposure in excess of 115 dBA over the period of a quarter of an hour cannot be permitted:

1.8. Corrosive substances:

a. All corrosive substances, including alkalis and acids, shall be stored and used by a person dealing with such substances at a building or other construction work in such a manner that it does not endanger the building worker and suitable protective equipment shall be provided by the employer to a building worker during handling or use of such substances at a building or other construction work and in case of spillage of such substances on the building worker, immediate remedial measures shall be taken;

b. While protection of the body could be ensured by use of corrosion resistant apparel/overalls, suitable goggles, gloves, apron, gum boots etc. shall be made available to all concerned personnel;

c. To deal with an accidental spillage of a corrosive substance on the body of a worker, the facility of eyewash fountain or water shower, as the case may be, shall be installed, within the easy reach of the workplace.

1.9. Eye protection:

a. Suitable personal protective equipment for the protection of eyes shall be provided and used by the building worker engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause hazard to his eyes;

b. Goggles or face shield or welding screen with suitable shade of glass/filters etc shall be provided for the protection of the eyes.

1.10. Overhead protection:

a. It shall be ensured that at the building or other construction site, overhead protection is erected along the periphery of every building under construction that shall be of fifteen meters or more in height when completed;

b. Overhead protection shall not be less than two meters wide and shall be erected at a height not more than five meters above the base of the building and the outer edge of such overhead protection shall be one hundred fifty millimeters higher than the inner edge thereof or shall be erected at an angle of not more than twenty degrees to its horizontal sloping into the building;

c. It shall be also ensured that at the building and other construction work that any area exposed to risk of falling material, articles or objects is roped or cordoned off or otherwise suitably guarded from inadvertent entry of persons other than building workers at work in such area.

1.11. Lifting and carrying of excessive weight:

a. No building worker lifts by hand or carries overhead or over his back or shoulders any materials, articles, tools or appliances exceeding in weight the maximum limits as set out in the following table unless aided by any other building worker or a mechanical device;

b. No worker aided by other workers, lift by hand or carry overhead or over their back or shoulders any materials, articles, tools or other appliances exceeding in weight the sum total of the maximum limits as prescribed in the concerned Rules, unless aided by a mechanical devices:

1.12. Protections against fall of persons –

a. All scaffolds/working platforms at height of two metres or more shall be fenced;
b. All guard-rails for the fencing of floor openings, gangways, elevated workplaces shall be made of sound material, good construction and possess adequate strength and be between 1 m and 1.5 m above platform level, consist of two rails (two ropes or chains may be used if they are sufficiently taut) and supporting stanchions;
c. Intermediate rails, ropes or chains shall be midway between the top and lower of edges of the top rail;
d. Sufficient number of stanchions or standard poles or uprights shall be maintained to ensure the required stability and resistance;
e. Guard-rails shall be free from sharp edges and be maintained in good repair;
f. Floor openings through which persons could fall, shall be guarded by covering or fencing;
g. If the means of protection is removed to allow the passage of persons or goods or other purpose, the same shall be replaced as soon as possible, while making temporary arrangements for reasonable degree of safety in the meanwhile;
h. Covers for floor opening shall be safe to walk on and if vehicles operate thereon it shall be safe for the same. This will require the contractor to have prior assessment of expected loads;
i. Cover for floor opening shall be secured by hinges, grooves, stops or other effective means against sliding, falling down or lifting out or any other inadvertent displacement;
j. Covers for any openings shall not constitute any hindrance to traffic and, as far as practicable, be flush with the floor;
k. If covers constitute as grids, the bars shall be spread not more than 5 cm apart;
l. Elevated workplaces at more than 2 m above the floor or ground shall be protected on all open sides by guardrails. It is commonly observed that fragile barricade tapes are used as a substitute of a strong and dependable fencing. This practice is prohibited. The barricade tapes can be used as markers/route guide only;
m. Elevated workplaces shall be provided with safe means of access and egress such as stairs, ramps or ladders according to suitability;
n. Persons employed at elevated workplaces or other situations at more than 2m from which they may fall, shall be protected by means of adequate safety nets, or platforms, or be secured by

safety belts with the lanyard properly anchored above the head level of the user. All possible effort shall be made to have strong and dependable mechanical arrangement.

1.13. Protection against fall of objects and materials:

a. Materials and objects such as scaffolding materials, waste materials or tools shall not be thrown up or down from heights, as they are liable to cause injury;
b. If materials and other objects cannot be safely lowered from heights, adequate precautions such as the provision of fencing, lookout men or barriers shall be provided to protect any person from injury.

1.14. Protection against entry of unauthorized persons:

a. Construction zones in the site and built up areas alongside main traffic routes shall be barricaded;
b. Unauthorized persons shall not be allowed access to construction sites and visitors shall be provided with the required protective equipment and it be ensured that they use them effectively.

1.15. Head protection and other protection apparel:

Every building worker who is required to –

a. Pass through or working within the areas where there is hazard of his being struck by falling objects or materials, shall be provided with safety helmets of the type approved and tested in accordance with the national standards;
b. Work in water or in wet concrete or in other similar work, shall be provided with suitable waterproof;
c. Work in rain or in similar wet condition, shall be provided with waterproof coat with hat;
d. Workers using or handling of alkalis, acid or other similar corrosive substances shall be provided with appropriate protective equipment in accordance with the approved standards;
e. Every building worker engaged in handling sharp objects or materials at a building or other constriction work, which may cause hand injury, shall be provided with suitable hand gloves in accordance with the approved standards.

1.16. Stability of structures:

a. No wall, chimney or other structure or part of a structure shall be left unsupported in such condition that it may fall, collapse or weaken due to wind pressure, vibration or due to any other reason. Entry of persons into such locations where tall structures are being built shall be regulated without a let up.

1.17. Safety of Structures and equipment and other safety concerns

a. Safety of structures like scaffoldings, platforms, gangways/walkways, towers, stairs, ladders, ramps, safety in excavation, formwork, falsework, demolition work, storage, handling and use of explosives, inflammable substances and hazardous materials, gas cutting and welding, use of electricity etc.; and equipment viz. construction machinery, crushers and batching plant, boiler and other pressure vessels, transport and material handling equipment, lifting appliances, vehicles etc., shall be operated and maintained as per approved norms and –
   i. They shall be made of sound material and of good construction, free from patent defects, provided with adequate safe guards, properly maintained, periodically inspected and strong enough to withstand safely the loads and stresses to which they may be subjected;
   ii. They shall carry enough factor of safety bearing in mind that the possibility of their abuse, which otherwise shall be prevented by constant and adequate supervision, cannot be ruled out altogether;
   iii. It is incumbent on the contractor to ensure that only competent and authorized persons operate the equipment or attend to electrical and mechanical systems and repair of faults or breakdowns etc.
b. Working in the confined space may involve certain serious hazards. Strict adherence to the conditions of Permit-to-work issued for the purpose is required;
c. Control of energy sources shall be ensured through Log-out/Tag-out practices.

1.18. Slipping, tripping, cutting, drowning and falling hazards:

a. The contractor shall keep all passageways, platforms and other places free from accumulations of dust, debris or similar material and from other obstructions that may cause tripping;

b. Any sharp projections or protruding nails or similar projections which may cause any cutting hazard to a building workers shall be removed or otherwise made safe by taking suitable measures;

c. No contractor shall allow any building worker at construction work to use the passageway, or a scaffold, platform or any other elevated working surface which is in slippery and dangerous condition and shall ensure that water, grease, oil or other similar substances which may cause the surface slippery, be removed or sanded/saw-dusted or covered with suitable material to make it safe from slipping hazard;

d. Wherever building workers are exposed to the hazarded of falling into water, they shall be provided with rescuing arrangement from such hazard and if it is considered necessary, well equipped boat or launch manned with trained personnel shall be provided by the contractor at the site of such work;

e. Every open side or opening into or through which a building worker, vehicle or lifting appliance or other equipments may fall at a building or other construction work shall be covered or guarded suitably to prevent such fall except where free access is necessary by reasons of their nature of the work;

f. Wherever building workers are exposed to the hazards of falling from height while employed on such work they shall be provided by the employer with adequate equipment or means for

saving them from such hazards, Such equipments or means shall be in accordance with the standards as laid down;

g. Whenever there is a possibility of falling of any martial, equipment or building worker at a construction site relating to a building or other construction work, adequate and suitable safety net shall be provided in accordance with the above stipulation;

2.0 SAFETY IN MATERIAL HANDLING AND WASTE DISPOSAL

2.1. GENERAL PROVISIONS:

a. All building materials stored in tiers shall be stacked, racked, blocked, interlocked or otherwise secured safely to prevent sliding, falling or collapse and in an orderly manner to avoid obstruction of any passageway at the place of work. Piles of materials shall be stored or stacked in such a manner as to ensure their stability;

b. Maximum safe load limits of floors within buildings and structures in kg/cm^2 shall be conspicuously posted in all storage areas, except for floor or slab on gradient. Maximum safe load shall not be exceeded. Material or equipment shall not be stored upon any floor or platform in such quantity as to exceed its safe carrying capacity;

c. Ailes and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or persons. Such areas shall be kept in good repair;

d. When a difference in road or working levels exist, means such as ramps, blocking or grading shall be used to ensure the safe movement of vehicles between two levels;

e. Material stored inside buildings under construction shall not be placed within 2 m of any hoist way or inside floor openings nor within 3.2 m of exterior wall which does not extend above the top of material stored;

f. Persons employed required to work on stored material in silos, hoppers and similar storage areas shall be equipped with lifelines and safety belts;

g. Non-compatible materials shall be segregated in storage;

h. Bagged materials shall be stacked by stepping back the layers and cross-keeping the bags at least every 10 bags high;

i. Materials shall not be stored on scaffolds or runways in excess of supplies needed for immediate operations;

j. Bricks stacks shall not be more than 2.2 m in height. When a loose brick stack reaches a height of 1.3 m it shall be tampered back 5 cm in every foot of height above the 1.25 m level;

k. When masonry blocks are stacked higher than 2 m, the stack shall be tapered back on half block per tier above the 2 m level;

l. Material or equipment shall not be stored or placed so close to any edge of a floor or platform as to endanger the safety of persons below or working in the vicinity. Where stacking, unshackling, stowing or unstaring of construction material or article, or handling in connection therewith cannot be safely carried out unaided, reasonable measures to guard against accident or dangerous occurrences shall be taken by shoring or otherwise to prevent any danger likely to be caused by such handling;

m. Stacking of material or article shall be made on firm foundation not liable to settle and such material or article and shall not overload the floor on which such stacking is made;

n. The material or articles shall not be stacked against partition or walls o f a warehouse or stores unless it is known that such partition or the wall is of sufficient strength to withstand the pressure of such materials or articles;

o. The materials or articles shall not be stacked to such a height and in such a manner as would render the pile of such stack unstable and cause hazards to the building workers or the public in general;

p. Where the building workers are on stack exceeding one point five meters in height, safe means of access to the stack shall be provided;

q. All stacking or unshackling operations shall be performed under the supervision of a responsible person for such stacking or unstacking;

r. The stacking of construction materials or articles shall not be made near the site of excavation, shaft, pit or any other such opening;

s. Stacks that may lean heavily or become unstable or collapse are barricaded shall be avoided;

t. Structural steel, poles, pipe, bar stock and other cylindrical materials, unless racked, shall be stacked and blocked so as to prevent sliding, spreading or tilting.

2.2. LUMBER:

a. Used lumber shall have all nails withdrawn before stacking;

b. Lumber shall be stacked on level and solidly supported sills;

c. Lumber piles shall not exceed 6 m in height provided that lumber is handled manually, shall not be stacked more than 5 m height;

d. Lumber shall be so stacked as to be stable and self-supporting.

2.3. STACKING OF CEMENT AND BAGS CONTAINING OTHER MATERIALS:

a. The cement or other material in bags shall be stacked in a header and stature-wise in rows alternately in not more than 10 numbers and there will be circulation of space of at least 600 mm in between two such rows;

b. While removing bags from the stack pile the stability of such stack pile shall be ensured;

c. Bags containing cement or lime shall be stored on a firm ground;

d. The materials like bricks, tiles or blocks shall also be stored on a firm ground;

e. Reinforcing steel shall be stored according to its shape, size and length and stack of reinforcing steel kept as low as possible;

f. No pipe shall be stored on rack or in stack where such pipe is likely to fall by rolling;

g. The angle of repose shall be maintained where loose materials are stacked;

h. When dust laden material is to be stored or handled, measures shall be taken to suppress the dust produced by such storing or handling and suitable personal protective equipment supplied to and used by the building workers working for such storing or handling.

2.4. DISPOSAL OF DEBRIS AND WASTE MATERIAL:

a. It shall be ensured that debris is

   i. Handled and disposed of by a method, which does not cause danger to the safety of a person and not allowed to accumulate so as to constitute a hazard;

   ii. Kept sufficiently moist to bring down the dust under control;

   iii. Not thrown inside or outside from any height of such building or other construction work;

b. Brought down by suitable means/chutes provided for the purpose and on completion of work, leftover building material, article or other substance or debris shall be disposed off as soon as possible to avoid any hazard to any traffic or person;

c. Whenever materials are dropped more than 6 m to any point lying outside the exterior walls of the building an enclosed chute of wood, or equivalent material shall be used;

d. When debris is dropped through holes in the floor without the use of chutes, the area where the material is dropped shall be completely enclosed with barricades not less than 1.1 m high and not less than 1.9 m back from the edge of the opening above. Signs warning of the hazard of falling material shall be posted at each level;

e. All scrap lumber, waste material and rubbish shall be removed from the immediate work area as the work progresses;

f. Disposal of waste material or debris as per the guideline issued by CPCB in compliance of Rule 10 sub-rule 1(a) of C & D Waste Management Rules, 2016).

g. All bio-degradable material shall be disposed off in the pit for making compost. Pellets can also be made from bio-degradable material

h. All solvent wastes, oil rags and flammable liquids shall be kept in fire resistant covered containers until removed from the work site.

2.5. HANDLING GAS CYLINDERS:

a. Gas cylinders shall not be lifted on bare slings. For lifting the cylinders, cage of suitable size shall be used and all cylinders shall be horizontally positioned in it. Such cage shall have fencing in such a way that there is no possibility of fall of cylinders from this cage.

2.6. RIGGING EQUIPMENT FOR MATERIAL HANDLING:

a. Rigging equipment for material handling shall be inspected prior to use in each shift as necessary during its use to ensure that it is safe. Defective rigging equipment shall be removed from service;

b. Rigging equipment shall not be loaded in excess of its recommended safe working load, as prescribed in the Indian standards;

c. Rigging equipment, when not in use, shall be removed from the immediate work area so as not to present a hazard to persons engaged in the area;

d. Special custom designed grabs, hooks, clamps, or other lifting accessories, for such units as modular panels, prefabricated structures and similar materials, shall be marked to indicate the safe working loads shall be proof tested prior to use 125% of their rated load;

e. Welded alloy steel chain slings shall have permanently affixed-durable identification standing size, grade, rated capacity and manufacturer.

2.7. FENCING OF MOTORS ETC

a. All motors, cogwheels, chains and friction gearings, flywheels, shafting and the other dangerous and moving parts of machinery (whether or not driven by mechanical power) and steam pipes shall be securely fenced and the fencing of dangerous parts of machinery not removed while such machinery is in motion or in use;

b. No part of any machinery which is in motion and which is not securely fenced, shall be examined, lubricated, adjusted or repaired except by a person skilled and trained for such examination, lubrication, adjustment or repairs and machine parts cleaned only when such machine is stopped;

c. When a machine is stopped for servicing or repairs, adequate measures shall be taken to ensure that such machine does not restart inadvertently and not only tag-out sign is required; it is also essential that an active system of isolating the power be applied.

2.8. PROTECTION AGAINST LIGHTNING

a. Where necessary, installations shall be protected against lightning, provided further that;

b. No bare conductors or bare current-carrying parts of equipment be permitted to be installed unless adequate precautions are taken to prevent direct pr indirect contact;

c. Only flame-proof equipment and conductors shall be installed at places where explosives or inflammable substances are stored, handled or used or where explosive atmosphere exits;

d. Persons competent and authorized only shall attend to electrical breakdowns and other operational faults and give or restore power to an equipment and such persons shall be easily identifiable by their dress or special helmet worn;

e. It will constitute a standard practice to switch off portable tools while shifting from one place to another or while leaving them behind unattended;

f. The contractor shall ensure that a system is in place to always keep tools well maintained.

2.9. VEHICULAR TRAFFIC

a. Whenever any building or other construction work is being carried on, or is located in close proximity to a road or any other place where any vehicular traffic may cause danger to building workers, it shall be ensured that such building or other construction work is barricaded and suitable warning signs and lights displayed or erected to prevent such danger and if necessary, a request in writing made to the concerned authorities to control such traffic;

b. All vehicles used at construction site shall comply with the requirements of the Motor Vehicles Act, 1988 (59 of 1988) and the Rules made hereunder;

c. The driver of a vehicle of any class or description operating at a construction site shall hold a valid driving license under the Motor Vehicles Act. 1988 (59 of 1988).

2.10. USE OF SAFETY BELT OR OTHER FALL ARREST SYSTEMS:

Wherever any work at a height of 3 m or more is carried out, use of a suitable fall arrest system is mandatory if the workplace has already not been provided with an otherwise reliable means of protection for preventing the fall of persons from that height, provided further that:

a. Safety belt, lanyard, life lines and devices for the attachment of such life lines shall conform to the approved standards;
b. Every building worker shall be supplied with safety belt and safety life lines for his protection and such building worker shall use such belts and life lines during the performance of his work;
c. All building workers using safety belt and safety life lines shall have the knowledge of safe use and maintenance of such belts and life lines and shall be supplied with necessary instructions for its use;
d. The responsible person for supervising the use of safety belts and safety lifelines shall inspect and ensure that such safety belts and lifelines are fit for use before taking them into use.

2.11. SAFETY NET AND ITS USE

a. Every safety net shall be of adequate strength, made of sound material and suitable for use and conform to the approved standards;
b. The responsible person for maintenance of safety nets and their use shall ensure safe fixing of such safety nets and provide such safety nets with suitable and sufficient anchorage so that the purposes for which such safety net is intended for use is served;
c. Use of multi-layer safety net to be ensured to avoid fall of material/objects.

2.12. STORAGE OF SAFETY BELTS AND NETS, ETC:

a. Proper arrangement shall be made for the safe storage of safety belts, safety lifelines and safety nets when they are not in use and are protected against mechanical damage, damages from chemicals and damages from biological agents.

2.13. SAFETY HELMETS AND SAFETY FOOTWEAR

a. The Engineer in-charge may declare whole or part of a site as the hardhat area and in such an eventuality it shall be the responsibility of the contractor to provide safety helmet of the approved quality to all personnel engaged in construction and erection work, including the visitors to the site;
b. Accordingly, wherever safety footwear is required for the safety of the personnel, the contractor shall provide the same of the approved type free of charge.

3.0 WELDING AND GAS CUTTING OPERATIONS

3.1 GAS WELDING:

3.1.1 GENERAL PROVISIONS:

a. All welders shall be provided with fire resistant protective clothing and equipment, such as fire resistant gauntlets and aprons, helmets and goggles with suitable filter lenses and its usage shall be ensured;
b. The welders shall not be allowed to wear clothing that is not free from grease, oil and other flammable material;
c. Adequate precautions shall be taken to protect persons working or passing near welding operations from dangerous sparks and radiation;
d. When welding or cutting is being done on materials containing toxic or harmful substances or liable to produce toxic or harmful fumes, adequate precautions shall be taken to protect workers from the fumes, either by
    i) Exhaust ventilation, or
    ii) Respiratory protective equipment;
    iii) Arrangement shall be made so that welding sparks do not fall down on the persons working below or material, which are combustible in nature and may be damaged with such sparks.
e. The oxygen pressure for welding shall always be high enough to prevent acetylene flowing back into the oxygen cylinder;
f. Acetylene shall not be used for welding at a pressure exceeding 1 atmosphere gauge;
g. Adequate precautions shall be taken to prevent:
    i) Fire being stated by sparks,
    ii) Slag or hot metal; and
    iii) Damage to fibre ropes from heat, sparks, slag or hot metal;
h. Precautions shall be taken to prevent flammable vapours and substances from entering the working area;

3.2. WELDING AT PLACES WITH FIRE RISKS:

a. Unless adequate precautions are taken, no welding or cutting operations shall be allowed near the place where combustible materials are stored, or near materials or plant where explosive or flammable dusts, gases or vapours are likely to be present or given off. If hot work permit system exists at the site, the same shall be followed;
b. Combustible materials and structures that cannot be removed from the vicinity of welding operations shall be shielded by asbestos or protected by other suitable means.

3.3. WELDING IN CONFINED SPACE:

When welding or cutting operations are being carried out in a confined space;

a. Adequate ventilation, by means of exhaust fans or forced drought as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be flown in by means of compressors to dilute the pollutants;

b. No blow pipe shall be left unattended inside a tank or vessel or other confined space during meal break or other interruption of the work;
c. The worker shall take all necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space; and
d. When necessary to prevent danger, an attendant shall watch the welders from outside.

3.4. WELDING ON CONTAINERS FOR EXPLOSIVE OR FLAMMABLE SUBSTANCES:

Welding or cutting operations on containers in which they are explosives or flammable substances shall not be allowed;

i) Welding or cutting operations on any container that has held explosive or where flammable gases may have been generated, shall only be undertaken,
ii) After the container has been thoroughly cleansed by steam or other effective means; and
iii) Found by air tests to be completely free from combustible gases and vapours; or
iv) After the combustible gas in the container has been completely replaced by an inert gas or by water;
v) If an inert gas is used as laid down in clause 4.2.3, after the vessel has been filled with gas, the gas shall continue to flow slowly into it thorough out the welding or cutting operations;
vi) Before starting any welding operations on, or otherwise applying heat to, closed or jacketed containers or other hollow parts, such containers or parts shall be adequately vented in suitable manner.

3.5. GAS CYLINDERS

a. Gas cylinders shall be inspected, stored, handled and transported in conformity with the requirements of Gas Cylinders Rules, 1981;
b. When in use, cylinders shall be held in upright positions by straps, collars or chains;
c. Devices referred to in clause 6.2 shall be such that the cylinders can be rapidly removed in an emergency;
d. Welders shall not temper with or attempt to repair safety devices and valves on gas cylinders;
e. When acetylene cylinders are coupled, flash back arrestor shall be inserted between the cylinder and the coupler block, or between the coupler bock and the regulator;
f. Only acetylene cylinders or approximately equal pressure shall be coupled;
g. No gas shall be taken from a cylinder unless a pressure reducing regulator has been attached to the valve;
h. Only the right pressure reducing regulator shall be used for the gas in the cylinder;
i. Cylinder valves shall be kept free from gases, grease, oil, dusts and dirt;
j. Leaky cylinders charged with acetylene or liquefied fuel gas shall be taken into the open air at a safe distance from any open flame or sparks.

3.6 HOSE

a. Only hose especially designed for welding and cutting operations shall be used to connect an oxy-acetylene torch to gas outlet;
b. Hose lines for oxygen and for oxy-acetylene shall be of different colours and preferably of different size;
c. Hose connections shall be sufficiently light to withstand without leakage a pressure twice thee maximum delivery pressure of the pressure regulators in the system;

d. Care shall be taken that hose does not become kinked or tangled, stepped on or run-over or otherwise damaged;
e. Any length of hose in which a flashback has burned, shall be discarded;
f. No hose with more than one gas passage shall be used;
g. Only soapy water shall be used for testing hose for leaks.

3.7. TROCHES

a. When torches are being changed, the gases shall be shut off at the pressure reducing regulators and not by crimping hose;
b. Torches shall be lit with friction lighters or other safe source but not with matches.
c. Electric welding equipment:
d. Welding machines shall be controlled by a switch mounted on or near the machine framework that, when opened, immediately cuts off the power from all conductors supplying the machine;
e. Welding circuit shall be so designed as to prevent the transmission of high potential from the source of supply to the welding electrodes;
f. The maximum open circuit voltage shall be in accordance with Indian Standards;
g. Electrode conductors or cables shall not be excessive in length and shall not be longer that necessary to perform the work;
h. Return conductors shall be taken directly to work and securely connected mechanically and electrically to it or to the work bench, floor etc. and to an adjacent metallic object;
i. Cable shall be supported so as not to create dangerous obstruction;
j. Motors, generators, rectifiers and transformers in arc welding or cutting machines, and all current carrying parts, shall be protected against accidental contact with uninsulated live parts;
k. Ventilating slots in transformer enclosures shall be so designed that no live part is accessible through any slot;
l. Frames of arc welding machines shall be effectively earthed;
m. In hand-operated arc welding machines, cables and cable connectors used in arc welding circuits shall be effectively insulated on the supply side;
n. The outer surface electrode holders of hand-operated arc welding machines, including the jaw so far as practicable, shall be effectively insulated;
o. Electrode holders of hand-operated arc-welding machines shall, if practicable, be provided with discs or shields to protect the operator's hands from the heat of the arcs;
p. Only heavy-duty cable with unbroken insulation shall be used;
q. Circuit connections shall be waterproof;
r. When lengths of cable have to be joined, only insulated connectors shall be used on the earth line and the electrode holder line;
s. Connections to welding terminals shall be made at distribution boxes, socket outlets, etc. by bolted joints;
t. Welding terminals shall be adequately protected against accidental contact by enclosures, covers or other effective means;
u. Electrode holder shall
    i. Have adequate current capacity;
    ii. Be adequately insulated to prevent shock, short-circuiting or flashovers.

3.8. OPERATIONS

a. Arc welding and cutting operations that are carried on at places where persons other than the welders are working or passing shall be enclosed by means of suitable stationary or mobile screens;
b. Walls and screens of both permanent and temporary protective enclosures shall be provided to absorb harmful rays from the welding equipment and prevent reflection, and if necessary, be painted or otherwise treated for the purpose;
c. When arc welding is done in damp confined spaces;
    i) Electrode holders shall be completely insulated; and
    ii) The welding machines shall be outside the confined space;
d. Welders shall take adequate precautions
    i) To prevent any part of their body from completing an electric circuit
    ii) To prevent contact between any part of the body and the exposed part of the electrode, or electrode when in contact with metal; and
    iii) To prevent wet or damaged clothing, gloves and boots from touching any live part;
e. Welding circuits shall be switched off when not in use;
f. Electrodes shall only be inserted in the holder with insulating means such as insulating gloves;
g. Electrode and return leads shall be adequately protected against damage;
h. Live parts of electrode holders shall be inaccessible when they are not in use;
i. Electric arc-welding equipment shall not be left unattended with current switched on.

4.0 SAFETY IN THE USE OF ELECTRICITY

4.1. GENERAL PROVISIONS

a. Before commencement of any building or other construction work, adequate measures shall be taken to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuit which may cause electrical hazard during the course of his employment and suitable warning signs shall be displayed and maintained at conspicuous places in Hindi and in local language understood by the majority of the building workers;

b. In workplaces where the exact location of underground electric power line is not known, the building workers using jack hammers, crow bars or other hand tools which may come in contact with a live electrical line shall be provided with approved insulated protective gloves and footwear;

c. As far as practicable, no wiring or cable, which may come in contact with water or which may be mechanically damaged or which may result in electric shock shall be left on ground or;

d. All electrical appliances and current carrying equipment used shall be made of sound material and adequately earthed;

e. All temporary electrical installations shall be provided with earth leakage circuit breakers;

f. It is required that all portable power-driven hand tools are provided with double insulation to secure a high degree of protection from electrical hazards;

g. Electrical installations shall comply with the requirements of any law for the time being in force, especially the Indian Electricity Act/Rules in particular with specific reference to the following:

   i) All parts of installations shall be of standard construction not lower, from the safety point of view, than the national standards, as applicable. All parts of electrical installations shall be so constructed, installed and maintained so as to prevent electrical fires, explosion and shock;

   ii) Earthing of metal work of electrical equipment, other than the parts which carry current, shall be provided and will conform to Electricity Act and IS: 3042 – 1966 (code of practice for earthing);

h. All parts of electrical installation shall be adequate size and characteristics for the work they may be called upon to do and in particular they shall:

   i) Be of adequate mechanical strength to withstand working conditions in construction operations; and

   ii) Be not liable to damage by water, dust or electrical, thermal or chemical action to which they me subjected to in construction operations;

i. All parts of electrical installations shall be so constructed, installed and maintained as to prevent the danger of electric shock; fire and external explosion;

j. It shall be made impossible for circuit breakers to be opened or closed inadvertently, by gravity or by mechanical impact;

k. Before operation of OCBs, oil level must be checked and the event of short, extra quantity must be filled;

l. Use of rubber gloves and rubber gum boots of tested quality where electric shock is likely to occur shall be provided, but these shall not be considered as providing adequate protection against the risk of electric shock in lieu of inbuilt safety arrangement in the system;

m. First-aid boxes, instruction for restoration of persons affected by electric shock shall be made;

n. Arrangement shall be made for sufficient number of CO_2/chemical powder type fire extinguishers/sand buckets etc.;

o. No electrical circuits shall ever be overloaded to the dangerous extent or beyond the rated capacity;

p. In confined areas, only 24 volt supply shall be used for every equipment, including hand-held portable tools and hand lamps;

q. All electrical appliances and outlets shall be clearly marked to indicate their purpose and voltage.

4.2. FUSES

a. Fuses shall bear markings indicating their rated current, whether they are of the fast or slow-breaking type and, as far as practicable, and their rated breaking capacity. Fuses as per need and of correct rating shall be used in the circuit;
b. Effective measures shall be taken to ensure that persons removing or inserting fuses will not be endangered, in particular by any adjacent live parts;
c. In case of blow of fuses only after finding out and correcting of the fault, new fuses shall be provided in the circuit.

4.3. SWITCHES

a. All switches shall be of enclosed type and so installed and earthed as to prevent danger in their operation;
b. Use of switches, which may connect or disconnect circuit through gravity, shall not be used.

4.4. MOTORS

a. All motors shall be equipped with a switch;
b. When a motor can be cut off from more than one place, where practicable, a stopping device shall be installed in the immediate vicinity of the motor;
c. Motors shall be so installed as to ensure that they can be adequately cooled;
d. Motors shall be effectively protected against over current;
e. Whenever the motors installed are in the open area where there is the possibility of fall of liquid corrosives or otherwise, it shall be suitably protected with covering;
f. Earthing shall be connected to all motors, generators etc. as prescribed in the Indian Electricity Rules, amended from time to time.

4.5. CONNECTIONS

a. At points where conductors are joined, branched or led into apparatus, they shall be:
    i. Mechanically protected, and
    ii. Properly maintained;

b. Conductors shall be joined, branched or led into an apparatus through junction boxes, bushings, glands or equivalent connecting devices;

c. Junction boxes or plug-out-socket couplings shall be used for joining cables wherever practicable;

d. When parts of conductors are joined together, or conductors are joined to one another or to an apparatus, the attachment shall be made by screwing, clamping, soldering, riveting, brazing, crimping, or equivalent means. Loose connections shall not be provided in any case;

e. Cable joints, junction boxes and connectors shall be protected as far as practicable, against traffic, fall of ground, water and other sources of damage;

f. Whenever armoured cables are joined, the junction boxes shall be bridged by a suitably conducive bond between the armouring of the cables.

4.6. TRANSPORTABLE AND PORTABLE ELECTRICAL EQUIPMENT:

a. The supply of electricity to portable apparatus shall not exceed 250v;

b. Hand-held and portable machines shall be equipped with a built-in switch to switch off power in case of emergency;

c. Hand-held electrically operated tools shall be provided with built-in switch to disconnect the circuit when the tool is not being used;

d. Portable electrical tools, unless flameproof, shall not be used in flammable or explosive atmosphere;

e. Only three-core cable shall be used for single-phase operated tools with the third core connected to earth

4.7. HAND LAMPS

a. Hand lamps shall be equipped with strong cover of glass or other transparent material;

b. Portable lamp holders shall have:

   i) All current –carrying part s enclosed;

   ii) Insulated handle; and

   iii) They shall operate at 24 v;

4.8. INSPECTION, MAINTENANCE

a. All electrical equipment shall be inspected before it is taken into use to ensure that it is suitable for its purpose of use;

b. At the beginning of every shift every person using electrical equipment shall make a careful external examination of the equipment and conductors for which he is responsible, especially flexible cables;

c. Periodic inspections, testing, maintenance of all electrical equipment is to be made and record of test of transformer oil and pit earthing shall be maintained;

d. Electrical conductors and equipment shall be repaired by the electrician only as far as practicable, no work shall be done live conductors or equipment;

e. Before any work is begun on conductors or equipment that does not have to remain live;

   i) The current shall be switched off;

   ii) Adequate precautions shall be taken to prevent the current from being switched on again;

   iii) The conductors or the equipment shall be tested to ascertain that they are dead;

   iv) The conductor and equipment shall be earthed and short-circuited; and

   v) Neighbouring live parts shall be adequately protected against accidental contact;

f. After work on conductors and equipment, the current shall only be switched on again on the orders of a competent person;

g. Electricians shall be provided with adequate tools, and person protective equipment, such as rubber gloves, mats etc.;

h. All conductors and equipment shall be considered to live unless there is certain proof to the contrary.

4.9. WORK IN THE VICINITY OF ELECTRICAL INSTALLATION

a. When work is to be done in the neighborhood of electrical conductors or installations, the contractor shall ascertain the voltage carried and the works shall not be allowed to reach to unsafe distance from them;
b. When any excavation is to be made or any bore-holed sunk, the contractor shall ascertain whether there are any underground conductors, in or in dangerous proximity to, the zone of operations;
c. No work shall be done in dangerous proximity to a conductor or an installation until it has been made dead;
d. Before work begins, work permit shall be obtained from the Engineer in-charge if live electricity lines/circuit are passing in close vicinity;
e. Before the current is restored, the contractor shall ensure that no work remain on the work site;
f. If conductor or an installation in the neighbourhood of which work is io be done can not be made dead, special precautions shall be taken and special instructions given to the workers so as to prevent danger by adequately enclosing or fencing;
g. If mobile equipment has to be employed in the neighbourhood of conductors or installations that cannot be made dead, its movement shall be so controlled as to keep it as a safe distance from them.

5.0 SAFETY IN THE USE OF HAND TOOLS AND POWER-OPERATED TOOLS

5.1 GENERAL PROVISIONS

a. All hands and power tools and similar equipment, shall be maintained in safe condition.

b. When power operated tools are designed to accommodate guards, they shall be equipped with such guards, when in use;

c. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;

d. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapours, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;

e. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive **on-off control.**

f. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

5.2. HAND TOOLS

a. The contractor shall not issue or permit the use of unsafe hand tools;

b. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;

c. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;

d. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

5.3. POWER OPERATED TOOLS

a. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;

b. The use of electric cords for hoisting or lowering loads shall not be permitted;

c. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected;

d. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being accidentally expelled;

e. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm^2 pressure at the tool a safety device on the

muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;

f. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm^2 and that too with effective chip guarding. The 2 kg/cm2 pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;

g. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;

h. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;

i. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;

j. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;

k. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;

l. Loaded tools shall not be left unattended;

m. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;

n. Driving into materials that can be easily penetrated shall be avoided unless backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;

o. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;

p. Only non-sparking tools shall be used in an explosive or flammable atmosphere;

q. All tools shall be used with the correct shield, guard or attachment as recommended by thee manufacturer.

5.4. ABRASIVE WHEELS AND TOOLS

a. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;

b. Grinding machines shall be equipped with suitable safety guards;

c. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 90^0, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 120^0. In either case, the exposure shall begin not more than 65^0 above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;

d. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;

e. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;

f. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of accidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180^0;

g. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;

h. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage, shall be used;

i. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;

j. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;

k. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

5.5. WOODWORKING TOOLS

a. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the **off-position;**

b. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is retensioned for a different speed, the marking shall be corrected to show the new speed;

c. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;

d. All portable power driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

6.0 SAFETY IN THE USE OF LADDERS AND STAIRS

6.1. GENERAL ASPECTS OF SAFETY RELATED TO USE OF LADDERS

a. Every ladder or step-ladder used in building or other construction work shall be of good construction, made of sound material and of adequate strength for the purpose for which such ladder or step-ladder is used;
b. When a ladder is used as a means of communication, such ladder shall be lashed to a fixed structure so that while working on such ladder it does not slip;
c. A ladder or step ladder shall not stand on loose bricks or other loose packing and have a level and firm footing;
d. No ladder shall be used which has a missing or defective rungs or rungs, which depend for support solely on nails, spikes or other similar fixing.

6.2. MATERIALS FOR LADDERS

a. Shall be constructed with upright of adequate strength and are made of straight-grained wood, free from defects and having the grain of such wood running length wise;

b. Shall have rungs made of straight-grained wood free for defects and mortised or securely notched into the upright, reinforcing metal ties, if wedges shall not secure the tenors of such ladders;

c. Where it is required, in case of use of fixed ladders, sufficient foot-hold and hand-hold shall be provided for use by the building worker;

d. Every ladder shall be -

    i. Secured so as to prevent undue swaying;
    ii. Equally and properly supported on each of its upright;
    iii. So used as not to cause undue sagging; and
    iv. Placed as nearly as possible at an inclination of four in one;

e. The use of all ladders and stepladders shall conform to the approved standards;
f. Wooden ladders shall be constructed with uprights of adequate strength as well as rungs made of wood free from visible defects and having the grains of the wood in the ladders running lengthwise and rungs mortised or rebutted into the uprights;
g. Uprights and rungs of metal ladders shall have a cross-section adequate to prevent dangerous deflection, shall be equal and not less than 25 cm or more than 35 cm;
h. Rungs of metal ladders shall be kept clean so as to prevent them from becoming slippery;
i. Portable ladders shall not exceed 9 m in length;
j. Every ladder or run of ladders rising to a height exceeding 9 m shall be provided with an intermediate landing, providing further that the intervals between landings shall not exceed 9 m. The landings shall be of suitable size and protected by railings;
k. Defective ladders that cannot be satisfactorily repaired shall be tagged Not Fit For Use and destroyed;
l. Wooden ladders shall not be painted, but oiled or covered with clean varnish or other transparent preservatives;
m. Metal ladders shall be protected against corrosion by being coated with rust-proof paint or by other means unless they are made of non-corrosive metals;

n. Every ladder shall rise at least 1 m above the highest point to be reached and have one of the uprights continued to that height to serve as a hand-rail at the top;
o. Ladders shall not stand on loose bricks or other loose packing but have a level and firm footing so that they are equally supported on each upright;
p. Every ladder shall be securely fixed so that it cannot move from its top and bottom points of rest and if it cannot be secured at the top, it shall be securely fastened at the base and if fastening at the top is also impracticable, it shall have a man stationed at the foot holding the end to prevent it from slipping;
q. Where a run of two or more ladders connects different floors, the ladders shall be staggered and a protective landing with the smallest practicable opening shall be provided at each floor;
r. A ladder having only one upright or a missing or dangerously defective rung shall not be used;
s. When a ladder is placed in position, the distance between the foot of a ladder and the base of the structure against which it rests shall be about one-quarter of its length;
t. Workers using ladders shall leave at least one hand free for climbing up and down, face the ladder, avoid wearing slippery footwear and avoid carrying heavy or bulky loads;
u. A ladder shall not be placed in front of a door that opens towards it unless the door is fastened or locked or guarded;
v. A ladder shall not be placed against a window frame unless the ladder is fitted with a board at the top so that the applied load is safely distributed over the frame;
w. Metal ladders shall not be used in the vicinity of live electrical equipment;
x. Adequate means shall be provided to prevent displacement of the ladder set up in public thoroughfare or where persons, vehicles etc. may accidentally collide with it.

6.3. PORTABLE STEPLADDERS

a. The length of portable stepladders shall not exceed 6 m and their back legs shall be adequately braced;
b. Stepladders exceeding 1.5 m in length shall have two or more cross-ties;
c. The spread between the front and back legs shall be restricted by means of hinged metal flat bars or high-grade fibre or other effective means;
d. When in the open position, treads of stepladders shall be horizontal.

6.4. PORTABLE TRESTLE LADDERS

a. The height of the trestle ladders shall not exceed 5.5 m;
b. The spread between the front and back legs shall be restricted by means of hinged metal flat bars or high-grade fibre or other effective means;
c. The front and back legs shall be joined at the top by bolted steel hinges of adequate dimensions or other effective means;
d. Both legs of trestle ladders shall be equipped with sufficient number of steel crossties.

6.5. EXTENSION LADDERS

a. The length of extension ladders shall not exceed 15 m;
b. Extension ladders shall be equipped with an effective lock and guide brackets by which the ladder can be extended, retracted or locked in any position;

c. The rungs of overlapping sections shall coincide so as to form double treads and shall be equipped with one or more extension ropes;
d. Extension ropes shall be securely anchored and run over suitable pulleys.

6.6 MECHANICAL LADDERS

a. Mechanical ladder is that ladder, which is a mechanically extendable ladder, mounted on a wheeled frame;
b. Mechanical ladder shall be equipped with guard-rails and toe-boards and a cage of heavy-gauge steel mesh;
c. If mechanical ladder has no railed platform or cage, workers using it shall be secured by suitable safety belt;
d. Mechanical ladders shall not be moved, while a person is on them, unless they have specially designed to ensure that perfect stability is maintained during movement.

6.7. FIXED LADDERS

a. Uprights of fixed ladders shall be at least 40 cm and shall be set an angle of 15^0 to the vertical;
b. Clearance at the back of the rungs shall be at least 15 cm and no obstruction within 75 cm of the face of the ladder;
c. There shall be at least 7.5 cm clearance between the ladder and the nearest fixed object;
d. When it is necessary for a ladder to pass closely through a hole in a platform or a floor, the edges of the hole shall be padded so as to prevent injury to the users;
e. The length of the runs of fixed ladder shall not exceed 9 m;
f. Landing platform shall be provided for each 9 m or fraction thereof;
g. As far as practicable, runs shall be staggered;
h. Runs from which a person could fall from more than 6 m shall be enclosed in a cage of heavy-gauge mesh or hoops;
i. Fixed ladders shall be firmly bolted or welded in position.

6.8. STAIRS

a. Stairs shall be of adequate strength to withstand safely the loads that they will have to carry;
b. Stairs used for the purpose of construction work shall have a clear width of at least 60 cm;
c. Stairs made of perforated material shall not have openings exceeding 1.2 cm in width;
d. No step of a stairway shall depend for its support solely on nails, spikes, screws or other similar fixing;
e. No stairway with missing or dangerously defective steps shall be used;
f. Every stairway that is at an angle of less than 30^0 from the vertical shall be provided with a secure handhold at the top landing place, either by extending one upright for at least 1 m or by other effective means;
g. Movable and removable stairs shall be adequately secured in the position of use;
h. In all building structures permanent stairs shall be constructed as soon as practicable;
i. When work on a building has progressed to a height of more than 18 m above the ground and it has not been practical to construct the permanent stairs, sufficient number of stairs shall be provided to ensure safe access to the working levels.

7.0 SAFETY IN THE USE OF LIFTING APPLIANCES & GEARS

7.1. CONSTRUCTION AND MAINTENANCE OF LIFTING APPLIANCES:

All lifting appliances, including their parts and working gear, whether fixed or movable, and any plant or gear used in anchoring or fixing of such appliances -

a. Shall be of sound construction, sound material, and of adequate strength to serve the purpose for which these are to be used and all such appliances shall be free from patent defects, and
b. Maintained in good repair and working condition;
c. Every drum or pulley around which the rope of any lifting appliance is carried, shall be of adequate diameter and sound construction in relation to such rope;
    i. Any rope that terminates at the winding drum of lifting appliance shall be securely attached to such drum and at least three dead turns of such rope remain on such drum in every operating position of such lifting appliance;
    ii. The flange of a drum projects twice the rope diameter beyond the last layer of such rope and if such rope and if such projection is not available, other measures like anti-slackness guards shall be provided to prevent such rope from coming off such drum;
d. Every lifting appliance shall be provided with adequate and efficient brakes which shall be:
    i) Capable of preventing fall of suspended load (including any test load),
    ii) Effectively controlling such load while it is being lowered, acting without shock and shall be attached with shoes that can be easily removed for running and which shall be simple and have easily accessible means of adjustment;
e. Provided that nothing contained above shall apply to **steam-winch** that can be operated as safely as with brakes.

7.2. CONTROLS OF EVERY LIFTING APPLIANCE SHALL BE SO;

a. Situated that the driver of such appliance at his stand or seat has ample room for operating and has an unrestricted view of building or other construction work, as far as practicable, and that he remains clear of the load and the ropes, and that no load passes over him;
b. Positioned with due regard to ergonomic considerations for proper operation of such appliance;
c. Located that the driver of such appliance remains above the appliance and shall have upon them or adjacent to them clear markings to indicate their purpose and mode of operations;
d. Provided, where necessary, with a suitable locking device to prevent accidental movement or displacement and shall move, as far as practicable, in the direction of the resultant load movement;
e. Wherever automatic brakes are provided, they shall automatically come to the neutral position in case of power failure.

7.3. TEST AND PERIODICAL EXAMINATION

7.3.1 Test: all lifting appliances including all parts and gears thereof, whether fixed or movable, shall be tested and examined by a competent person before being taken into use for the first time or after it

has undergone any alteration or repairs liable to affect its strength or stability or after erection on a site and also once at least in every five years, in the manner as specified;

7.3.2. Examination: all lifting appliances shall be thoroughly examined by a competent person at least in every twelve months and where the competent person making such examination forms the opinion that the lifting appliance cannot continue to function safely, he shall forthwith give notice in writing of his opinion to the contractor.

7.4. AUTOMATIC LOAD INDICATOR

a. Cut-out shall be provided which automatically arrests the movement of the lifting parts of every crane if the load exceeds the safe working load, wherever possible;

b. Wherever the above provisions cannot be applied and if it is not possible to install an automatic safe load indicator, in that case, provision of a table showing the safe working loads at the corresponding inclinations or radii of the jib on the crane shall be considered sufficient.

7.5. INSTALLATION:

Fixed lifting appliances shall be installed by a competent person in a manner that

a. Such appliances cannot be displaced by the load, vibration or other influences;

b. The operator of such appliance is not exposed to danger from loads, ropes or drums;

c. The operator can either see over the zone of operation or communicate with all loading and unloading points by signal, or other communication system;

d. Adequate clearance is provided between parts or loads of lifting appliances and between the fixed objects such as walls and posts, or electrical conductors;

e. The lifting appliances; when exposed to wind loading, are given sufficient additional strength, stability and rigidity to withstand such loading safely;

f. No structural alterations or repairs are made on any part of the lifting appliances that affect the safety of such appliances without obtaining the opinion of the competent person to this effect.

7.6. WINCHES

a. Winches shall not be used if their control levers operate with excessive friction or play;

b. Double gear winches shall not be used unless a positive means of locking the gearshift is provided;

c. There shall be no load other than the fall and the hook assembly on the winch while changing gears on a two-gear winch;

d. Adequate protection shall be provided to the winch operator against abnormal weather;

e. Temporary seats or shelters for winch operators that may pose hazard to the winch operator or any other building workers shall not be allowed to be used;

f. Control levers shall be secured in the neutral position and, whenever possible, the power shall shut off if the winch is left unattended.

7.7. IN USE OF EVERY STEAM-WINCH

a. Measures shall be taken to prevent escaping steam from obscuring any part of the construction site or other workplace or from otherwise hindering or injuring any building worker;

b. Extension control levers which tend to fall off their own weight shall be counter-balanced;

c. Winch operators shall not be permitted to use the which control extension levers except for short handles on wheel type controls and that such levers shall be of adequate strength, secure and fastened with metal connections at the fulcrum and at the permanent control lever;

d. In use of every electric winch, no building worker shall be permitted to transfer, alter or adjust electric control circuits in case of any defect in such winch;

7.8. ELECTRIC WINCHES SHALL NOT BE USED FOR BUILDING WORK WHERE

a. The electromagnetic brake is unable to hold the load; or

b. One or more control points either hoisting or lowering are not operating properly.

7.9. BUCKETS:

It shall be ensured that tip-up buckets are equipped with a device that effectively prevents accidental tipping.

7.10. IDENTIFICATION AND MARKING OF SAFE WORKING LOAD:

a. Every lifting appliance and loose gear shall be clearly marked for its safe working load and identification by stamping or other suitable means;

b. Every derrick (**other than derrick crane**) shall be clearly marked for its safe working load when such derrick is used either in single purchase with lower block or in union purchases in all possible block positions;

c. The lowest angle to the horizontal, to which the derrick may be used, shall be legibly marked;

d. Every lifting appliance having more than one working load shall be fitted with effective means to enable the operator to determine safe working load at each point under all conditions of use;

e. Means to ascertain the safe working load for lifting gears under such conditions in which such gears may be used shall be provided to enable a worker using such gears and such means safely, which shall comprise:

   i) Marking of the safe working load in plain figures or letters upon the sling or upon a tablet or ring of durable material attached securely thereto in case of chain slings; and

ii) The means specified or notices so exhibited as can be easily read by any concerned building worker stating the safe working load for the various sizes of the wire rope slings used.

7.11 LOADING OF LIFTING APPLIANCES AND LIFTING GEARS

a. No lifting appliance, lifting gear or wire rope shall be used in an unsafe way and in such a manner as to involve risk to life of building workers and they are not loaded beyond their safe working load except for testing purposes under the direction of a **competent person** in the manner as specified in schedule;

b. No lifting appliance and lifting gear, or any other material-handling appliance shall be used if the Inspector having jurisdiction under the Building and Other construction (regulation of employment and conditions of service) Act/Rules is not satisfied with reference to a certificate of test or examination or to an authenticated record maintained as provided under the Rules or if in his view the lifting appliance, lifting gear or any other material handling appliance is not safe for use in building or other construction work;

c. No pulley block shall be used unless the safe working load and its identification are clearly marked on such block.

7.12. OPERATOR'S CAB OR CABIN SHALL

a. Be made of fire resistant material;

b. Have a suitable seat, a foot rest and protection from vibration;

c. Afford the operator an adequate view of the area of operation**;**

d. Afford the necessary access to working parts in the cab;

e. Afford the operator adequate protection against the weather;

f. Be adequately ventilated; and

g. Be provided with a suitable fire extinguisher.

7.13. OPERATION OF LIFTING APPLIANCES:

Operator of every crane or lifting appliance shall possess adequate skill and training in the operation of the particular lifting appliances, provided further that

a. No person under eighteen years of age shall be in control of any lifting machine, scaffold winch, or give signals to the operator;

b. Precaution shall be taken by the trained operator to prevent lifting appliance from being set in motion inadvertently;

c. The operation of lifting appliances shall be governed by signals in conformity with the approved standards;

d. The operator's attention shall not be distracted while he is working;

e. No crane, hoist, winch or other lifting appliance or any part of such crane, hoist, winch or other lifting appliance shall, except for testing purposes, be loaded beyond the safe working load;

f. During the hoisting operation, effective precaution shall be taken to prevent any person from standing or passing under the load in such operation;

g. Operator shall not leave lifting appliance unattended while power is on or the load is suspended to such appliance;

h. No person shall ride on a suspended load of any lifting appliance;

i. Every part of a load in course of being hoisted or lowered shall bee adequately suspended and supported to prevent danger;

j. Every receptacle used for hoisting bricks, tiles, slates or other material shall be suitably enclosed as to prevent the fall of any such material;

k. The hoisting platform shall be enclosed when loose material or loaded wheel barrows are placed directly on such platform or lowering such materials or wheel barrows;

l. No material shall be raised, lowered or slewed with any lifting appliance in such a way as to cause sudden jerks to such appliance;

m. In hoisting a barrow, any wheel of such barrow shall not used be as a means of support unless adequate steps have been taken to prevent the axle of such wheel from slipping out of its bearing;

n. Long objects like planks or girders shall be provided with tag line to prevent any possibility of danger while raising or lowering such objects;

o. During the process of landing or material, a building worker shall not be permitted to lean out into empty space for finding out the loading and unloading of such material;

p. When hoisting of load is done in an enclosed space, neither the lifting material nor the boom shall project outside the enclosed space;

q. Adequate steps shall be taken to prevent a load, in the course of being hoisted or lowered from coming into contact with any object to avoid any displacement of such load and appropriate appliances provided and used for guiding heavy loads when raising or lowering heavy loads to avoid crushing of hands of building workers during such raising or lowering of loads.

7.14. HOISTS

a. Hoist towers shall be designed according to the relevant national standards;

b. Hoist shafts shall be provided with rigid panels or other adequate fencing at the ground level on all sides of such shafts and at all other levels on all sides of the access to such shafts while the walls of hoist shafts, except at approaches, extend at least two meters above the floor or platform of access to such shifts;

c. Approaches to hoist shall be adequately lit and provided with gates that shall be guarded to maintain visibility at least of two meters height; and equipped with a device, which requires such gate to be closed before the platform of such hoist can leave the landing, and prevents the gate from being opened unless such platform is at the landing;

d. The guides of hoist platforms shall offer sufficient resistance to bending and to bucking in the case of jamming, by providing a safety catch;

e. Overhead beams and their supports are capable of holding the total maximum live and dead loads that such beams and supports will be required to carry, with a safety factor of at least five;

f. A clear space shall be provided –

   i. Above the highest stopping place of a cage or platform to allow sufficient unobstructed travel of such cage or platform in case of over-winding and

   ii. Below the lowest stopping place of such cage or platform;

g. Adequate covering shall be provided above the top of hoist shafts to prevent materials from falling into such shifts;

h. Outdoor hoist towers shall be erected on adequately firm foundations and securely braced, guyed and anchored;

i. A ladder way shall extend from the bottom to the top of every outdoor hoist tower in case no other ladder way exists within easy reach and such ladder way shall comply with the relevant national standards;

j. The rated capacity of a hoisting engine shall at least be one and a half times the maximum load that such engine will be required to move;

k. All gearing on a hoisting engine shall be securely enclosed;

l. Steam piping of hoisting engine shall be adequately protected against accidental contact of such piping with a building worker;

m. Electrical equipment of a hoisting engine shall be effectively earthed;

n. A hoist shall be provided with suitable devices to stop a hoisting engine as soon as the platform of such hoist reaches its highest stopping place;

o. A hoisting engine shall be protected by suitable cover against weather and falling objects;

p. A hoisting engine set up in a public thoroughfare shall be completely enclosed;

q. All exhaust steam pipes shall discharge steam in such a manner that the steam so discharged does not scald any person or obstruct the operator's view;

r. The motion of a hoist shall not be reversed without first bringing it to rest to avoid any harm from such reverse motion;

s. A hoist not designed for the conveyance of persons shall not be set in motion from the platform of such hoist;

t. Pawls and ratchet wheels of a hoist, requiring disengagement of such pawls from such ratchet wheels, before the platform of such hoist is lowered, shall not be used;

u. A platform of a hoist shall be capable of supporting such maximum load that such platform may carry with a safety factor of at least three;

v. A platform of a hoist shall be equipped with suitable safety gear which can hold such platform with its maximum load in case its hoisting rope breaks;

w. On platform of a hoist, the wheel barrows or truck shall be efficiently blocked in safe positions;

x. A cage of a hoist or platform where the building workers are required to enter into such cage or to go on such platform at landing levels, shall be provided with a locking arrangement to prevent such cage or platform from moving during the time a worker enters or leaves such cage or platform;

y. The sides of platform of a hoist which are not used for loading or unloading, shall be provided with toe-board and enclosures of a wire mesh or any other suitable means to prevent the fall of any part of a load from such platform, further provided that

   i. The platform of a hoist, which has any probability of falling of any part of a load from it, shall be provided with an adequate covering to prevent such fall;

   ii. The counter weights of a hoist consisting of an assemblage of several parts shall be so constructed that such parts shall be rigidly connected together;

   iii. The counter weights of a hoist shall run between guides;

   iv. At every level of work the building workers shall be provided with adequate platforms for performing such work;

   v. A legible notice in Hindi as well as in a local language shall be displayed in a conspicuous place of the platform of a hoist and that such notice shall state the maximum carrying capacity of such hoist in kilograms on the hoisting engine;

   vi. On a hoist authorized and certified for the conveyance of the persons on the platform or in the cage and such notice shall state the maximum number of persons to be carried on such hoist at one time;

   vii. On a hoist carrying goods and other materials such notice shall state that such hoist is not meant for carriage of persons.

7.15. FENCING AND MEANS OF ACCESS TO LIFTING APPLIANCES

a. Safe means of access shall be provided to every part of lifting appliances;

b. The operator's platform on every crane or tip driven by mechanical power shall be securely fenced and provided with safe means of access and where access to such platform is by a ladder, the sides of such ladder shall extend to a height reasonable beyond such platform or some other suitable handhold shall be provided in the platform;

c. The handling place on such platform shall be maintained free from obstruction and slipping; and

d. In case the height of such ladder exceeds six meters, the resting platforms shall be provided on such ladder at every six meters of its height and where the distance between last platform so provided and the top end of such ladder is more than two meters then on such top end.

7.16. RIGGING OF DERRICKS:

Every derrick shall have current and relevant rigging plans and any other information necessary for the safe rigging of such derrick and its gear.

7.17. SECURING OF DERRICK FOOT:

Appropriate measures shall be taken to prevent the foot of a derrick from being lifted out of its socket or supports.

7.18. CONSTRUCTION AND MAINTENANCE OF LIFTING GEAR

a. Every lifting gear shall be –

i. of good design and construction, sound material and adequate strength to perform the work for which it is used;

ii. free from patent defects; and

iii. properly maintained in good repair and working order;

b. Components of the loose gear, at the time of its use, shall be renewed if one of its dimensions at any point has decreased by ten per cent or more;

c. A chain shall be withdrawn from use when it is stretched and increased in length which exceeds five per cent of its length or when a link of such chain is deformed or is otherwise damaged or defects in the welds have appeared on it;

d. Rings, hooks, swivels and end links attached to a chain shall be of the same materials as that of such chain;

e. The voltage of electric supply to any magnetic lifting device shall not fluctuate by more than **plus** or **minus** 10%.

7.19. TEST AND PERIODICAL EXAMINATION OF LIFTING GEARS

a. A lifting gear shall be initially tested for the manufacturer by a competent person in a manner specified as per schedule annexed before taking into use or after undergoing any substantive alterations which renders its any part liable to affect its safety and such gear alter such test shall subsequently be retested for the use of its owner at least once in every five years;

b. A lifting gear in use shall thoroughly examined once at least in every twelve months by a competent person;

c. A chain in use shall be thoroughly examined at least once every month by a responsible person for its use;

d. Certificates of initial and periodical test and examinations of loose gears shall be obtained in the form annexed.

7.20. ROPES

a. No rope shall be used for building or other construction work unless -

i) It is of good quality and free from patent defects; and

ii) In the case of wire rope, it shall be tested and examined by a competent person in the manner annexed;

iii) Every wire rope of lifting appliance or lifting gear used for building or other construction work shall be inspected by a responsible person for such use, once at least in every there month;

b. Provided that after if any such wire is broken in such rope, the responsible person shall thereafter inspect it once at least in every month and ensure that;

c. No wire rope shall be used for building or other constructing work if in any length of eight diameters of such wires, the total number of visible broken wires exceed ten per cent of the total number of wires in such rope, or such rope shows signs of excessive wear, corrosion or other defects which in the opinion of the person who inspects it, is unfit for use;

d. Eye splices and loops of ropes for the attachment of hooks, rings and other such parts to wire rope shall be made with suitable thimble;

e. A thimble or loop splice made in any wire rope sling shall conform to the following standards, namely:

   i) Wire rope sling shall have at least three tucks with full strand of rope and two tucks with one-half of the wires cut out of each of such strand in all cased, such strands shall be tucked against the lay of the rope;

   ii) Protruding ends of such strands in any splice of wire rope slings shall be covered or treated so as to leave no sharp points;

   iii) A fiber rope or a rope sling shall have at least four tucks, tail of such tuck being whipped in a suitable manner; and

   iv) A synthetic fiber rope or rope sling shall have at least four tucks with full strands followed by further tuck with one-half filaments cut out of each of such strand and final tuck with one-halt of the remaining filaments cut out from such strands. Any portion of the splices containing such tucks, with reduced number of filaments, shall be securely covered with suitable tape or other materials;

   v) Provided further that nothing contained above shall apply where any other form of splice, which may be shown to be as efficient as the splice with above standards, shall be used.

7.21. HEAT TREATMENT OF LIFTING GEARS

a. All chains other than bridle chains attached to derricks and all rings, hooks, shackles and swivels used in hoisting or lowering of such derricks shall be effectively annealed under supervision of a competent person and at the following intervals, namely:

   i) Such chains, rings, hoods, shackles and swivels which are not more than twelve and a half millimeter of length annealed at least once in every six months; and

   ii) All other such chains rings hooks shackles and swivels shall be so annealed at least once in every twelve months;

b. Provided that the clause (a) above shall not apply to -

   i) Pitched chins, working on sprocket or sprocket wheels;

   ii) Rings, hooks and swivels permanently attached to pitched chains, pulley blocks or weighing machines, and

   iii) Hooks and swivels having ball bearings or other case hardened parts;

c. A chin or a loose gear made of high tensile steel or alloy steel shall be plainly marked with a mark indicating that it is so made;

d. No chain or loose gear made of high tensile steel or alloy steel shall be subjected to any form of heat treatment except where such treatment is necessary for the purpose of repair of such chain or loose gear and that such repair shall be made under the direction of the competent person;

e. That the wrought iron gear, the past history of which is not traceable, shall be suspected of being heat treated at incorrect temperature shall be normalized before using it on any building or other construction work.

7.22. CERTIFICATE TO BE ISSUED AFTER ACTUAL TESTING AND EXAMINATION ETC:

A competent person shall issue a certificate after actual testing or examination of the apparatus specified and record of such test or examination shall be maintained for inspection.

7.23. REGISTER OF PERIODICAL TEST, EXAMINATION AND CERTIFICATION THEREOF

a. A register in the form annexed shall be maintained and particulars of such test and examination of lifting appliances, lifting gears and heat treatment as required shall be entered in such register;

b. Certificate in respect of each of the following shall be obtained from a competent person:

i) In cases of initial and periodical test and examination of the lifting appliances such as Winches, Derricks and their accessory gears, Cranes or Hoists and their accessory gears;

(ii) In case of test, examination and re-examination of loose gears;

(iii) In case of test and examination of wire ropes;

(iv) In case of heat treatment and examination of loose gears;

(v) In case of annual thorough examination of the loose gears, except where required particulars of such exemption have been enclosed in the register referred to in Form annexed and such certificates are attached to the register referred to as above and certificates kept at such construction site in case such register and certificate relate to lifting appliances, loose gear and wire ropes and

c. Produced on demand and retained for at least five years after the date of the last entry made in such register;

d. No lifting appliance or lifting gear in respect of which an entry is required to be made in register referred to above and certificate of test and examination are required to be attached in such register in the manner as specified, shall be used for building or other construction work unless the required entries have been made in such register and certificates.

7.24. VACUUM AND MAGNETIC LIFTING GEAR

a. No vacuum lifting gear, magnetic lifting gear or any other lifting gear where the load on it is held by adhesive power, shall be used while workers are performing operations beneath such gear;

b. A magnetic lifting gear used in connection with building or other construction work shall be provided with an alternative supply of power, such as batteries, which may come into operation immediately in the event of failure of the main power supply;

c. No building worker shall work within the swinging zone of the lifting gear or load or building or other construction material suspended to such lifting gear.

7.25. KNOTTING OF CHAINS AND WIRE ROPES:

No chain or wire rope with a knot in it shall be used in building or other construction work.

7.26. CARRYING OF PERSONS BY MEANS OF LIFTING APPLIANCES ETC.

a. No building worker shall be raised, lowered or carried by a power driven lifting appliance, except
   i. On the drive's platform in the cage of a crane; or
   ii. On as hoist; or
   iii. On an approved suspended scaffold;

b. Provided that a building worker may be raised, lowered or carried by a power driven lifting appliance:
   i. In circumstances where the use of a hoist or of a suspended scaffold shall not reasonably be practicable, or
   ii. On an aerial cableway or aerial ropeway, provided further that the following requirements are met:
   iii. That the appliance referred to above can be operated from one position only and that
   iv. Any winch used in connection with the appliance shall also comply with the requirements as laid down above.

c. The appliance referred to above shall not carry any person except:
   i. In a chair or cage,
   ii. In a skip or other receptacle at least three feet deep which shall be suitable for safe carriage of a person and any such chair, cage, skip or other receptacle shall be made of good construction, sound material, and adequate strength and properly maintained with suitable means to prevent any occupant therein from falling out of it and shall be free from any material or tools which may interfere with the handhold or foothold of such occupant or otherwise endanger him; and
   iii. Those suitable measures shall be taken to prevent the chair, cage skip or other receptacle from spinning or tipping in a manner dangerous to any occupant therein.

7.27. HOISTS CARRYING PERSONS

a. No building worker shall be carried with the help of a hoist unless it is provided with a cage which:
   i) Is so constructed as to prevent, when its gates are shut, any building worker carried by such hoist from falling out of it or from being trapped between any part of such cage and any fixed structure or other moving part of such hoist or from being struck by articles or materials falling down the hoist way on which such hoist is moving; and
   ii) Is fitted on each of its side from which access is provided to a landing place with a gate which has efficient interlocking or other devices to secure so that such gate cannot be opened except when such cage is at a landing place and that such cage cannot be moved away from any such place until such gate is closed;

b. Every gate in the hoist way enclosure of such hoist used for carrying persons shall be fitted with efficient interlocking or other devices to secure so that such gate cannot be opened except when the cage of such gate is at the landing place and that such cage cannot be moved away from the landing place until such gate is closed;

c. In every hoist used for carrying building workers there are provided with suitable and efficient automatic devices to ensure that the cage of such hoist comes to rest at a point above the lowest point to which such gave may travel.

7.28. ATTACHMENT OF LOADS

a. When a sling is used to hoist long materials, a lifting beam shall be used to space the sling legs for proper balance and when a load is suspended at two or more points with slings, the eyes of the lifting legs of such slings shall be shackled together and such shackled or eyes of the shackled slings shall be placed on the hook or the eyes of such lifting legs shall be shackled directly to the hoisting block, ball or balance beam, as the case may be;

b. Every container or receptacle used for raising or lowering stone, bricks tiles, slates or other similar objects shall be so enclosed with the hoist as to prevent the fall of such objects;

c. A loaded wheel barrows placed directly on a platform of a hoist for raising or lowering of such wheel barrows shall be so secured that such wheel barrows cannot move and such platform shall be enclosed to prevent the fall of the contents kept in such wheel barrows;

d. Landings of hoists shall be so designed and arranged that building workers on such hoist be not required to lean out into empty space for loading and unloading on any material from such hoist

7.29. TOWER CRANES

a. No person other than the operator trained and capable to work at heights shall be employed to operate tower cranes;

b. The ground on which a tower crane stands shall have adequate bearing capacity;

c. Bases for tower cranes and trucks for rail mounted tower cranes shall be firm and leveled and such cranes erected at a reasonably safe distance from excavations and operated within gradient limits as specified by the manufacturer of such cranes;

d. Tower cranes shall be sited where there is a clear space available for erection, operation and dismantling of such cranes;

e. Tower cranes shall be sited in such a way that the loads on such cranes shall not be handled over any occupied premises, public thoroughfares, railways or near power cables, other than construction works for which such cranes are used;

f. Where two or more tower cranes are sited and operated, every care shall be taken to ensure positive and proper communication between operators of such cranes to avoid any dagger or dangerous occurrences;

g. Tower cranes shall not be used for loading magnet, or demolition ball service, piling operation or other similar operations which could impose excessive load stresses on the crane structure of such cranes;

h. The instruction of the manufacturer of a tower crane and standard safe practices regarding such cranes shall be followed while operating or using such cranes.

7.30. QUALIFICATION OF OPERATOR OF LIFTING WINCHES AND OF SIGNALER ETC.

a. No person shall be employed to drive or operate a lifting appliance whether driven by mechanical power or otherwise or to give signals to driver of operator of such lifting appliance or to work as an operator of a rigger or derricks unless he is

i) Sufficiently competent and reliable;

ii) Possesses the knowledge of he inherent risks involved in the operation of lifting appliance;

iii) Medically examined periodically as specified and

iv) Is above eighteen years of age.

8.0 SAFETY IN THE USE OF TRANSPORT, EARTHMOVING EQUIPMENT & OTHER CONSTRUCTION MACHINERY

8.1 EARTHMOVING EQUIPMENT AND VEHICLES

a. All vehicles and earthmoving equipment shall be made of good material, proper design and sound constructional and be sufficiently strong for the purpose for which such equipment are properly used in accordance with standard safe operating practices;

b. Provided that the truck or trailer employed for transporting freight containers shall be of the size sufficient to carry the containers, without over hanging and provided with twist locks conforming to approved standards, at all the four corners of each of such use by an authority under the relevant law for the time being in force and is inspected by a responsible person, at least once in a month and record of such inspection shall be maintained:

c. All transport or earth moving equipment and vehicles shall be inspected at least once a week by a responsible person and in case any defend is noticed in such equipment or vehicle it shall be immediately taken out of use;

d. Power trucks and tractors shall be equipped with effective brakes, headlights and tail lamps and maintained in good repair and working order;

e. Side stanchions on power trucks and trailers for crying heavy and long objects shall be

i. Of sound construction and free from defects;

ii. Provided with tie chains attached to the top across the loads for preventing such stanchions from spreading out; and

iii. Kept in position while loading and unloading;

iv. Safe gangways provided for to and fro movement of building workers engaged in loading and unloading of lorries, trucks, trailers and wagons;

v. Trucks and other equipment shall not be loaded beyond their safe capacity and carry workers engaged in loading and unloading of lorries, trucks trailers and wagons in an unsafe condition;

vi. Handles of trucks shall be so designed as to protect the hands of the building workers working on such trucks, or such handles provided with knuckle guards;

vii. No unauthorized person shall ride the transport equipment employed in such work;

viii. A driver of a transport equipment shall maneuver such equipment under the direction of a signaler;

ix. Adequate precaution such as isolating the electric supply or erecting overhead barriers of a safe height shall be taken when earth moving equipment or vehicles are required to operate in dangerous proximity to any live electric conductor;

x. Vehicles and earth moving equipment shall not be left on a slope with the engine of such vehicles or equipment running;

xi. All earth moving equipment, vehicles or other transport equipment shall be operated only by such person who are adequately trained and possess such skills as required for safe operation of such equipment, vehicle or other transport equipment.

8.2. POWER SHOVELS AND EXCAVATOR

a. A shovel or an excavator whether operated by steam or electric or by internal combustion, shall be constructed, installed, operated, tested and examined as per approved standards;

b. Excavator equipped for use as a mobile crane shall be examined and tested in accordance with the requirements for such mobile cranes as laid down by the manufacturer; and

c. Fitted with an automatic safe working load indicator;

d. Buckets or grabs of power shovels shall be propped to restrict the movement of such buckets or grabs while being repaired or while the teeth of such buckets or grabs are being changed.

8.3. BULLDOZER

a. Operator of every such bulldozer before leaving the dozer shall take the following steps:

i) Apply the brakes;

ii) Lower the blade and sipper and

iii) Put the shift lever into neutral;

iv) Dozer left on level ground at the close of the work for which such bulldozer is used;

v) The blade of a bulldozer kept low when such bulldozer is moving uphill;

vi) The bulldozer blades not used as brakes except in an emergency.

8.4. SCRAPERS

a. A tractor and scraper shall be joined by safety line at the time of its operation;

b. The scraper bowls shall be propped while blades of such scraper are being replaced;

c. A scraper moving downhill shall not be left in gear.

8.5. MOBILE ASPHALT LAYERS & FINISHERS

a. A mixture elevator shall be located within a wooden or sheet metal enclosure with a window for observation, lubrication and maintenance;

b. Bitumen scoops shall have adequate covers;

c. When asphalt plants are working on public road, adequate traffic control shall be established on such road and the building workers working with such plant provided with reflective jackets;

d. A sufficient number of fire extinguishers shall be kept in readiness at such workplace where fire hazards may exist;

e. The materials shall be loaded on the elevator after the drying drain has warmed up of such elevator;

f. No open light shall be used for ascertaining the level of asphalt;

g. Inspection opening shall not be opened till there is a pressure in the boiler, which may cause injury to building workers.

8.6. PAVERS:

Pavers shall be equipped with guards suitable to prevent building workers from walking under the skip of such pavers.

8.7. Road rollers: Before a road roller is used on the ground, such ground shall be examined for its bearing capacity and general safety, especially at the edges of slopes such as embankment on such grounds and shall not be moved downhill with the engine out of gear.

8.8. GENERAL SAFETY IN RESPECT OF POWERED CONSTRUCTION MACHINERY

a. Every vehicle or earthmoving equipment shall be equipped with -

i) Silencers;

ii) Tail lights

iii) Power and hand brakes;

iv) Reversing alarm; and

v) Search light for forward and backward movement, which are required for safe operation of such vehicle or earthmoving equipment;

b. The cab of vehicle or earthmoving equipment shall bee kept at least one meter from the adjacent face of a ground being excavated;

c. When cranes of shovel are traveling, the boom of such crane or shovel shall be in the direction of such travel and the bucket or scoop attached to such crane or shovel raised and without load except when such traveling is downhill.

9.0 SAFETY IN THE PROVISION OF RUNWAYS AND RAMP

9.1. USE OF RUNWAYS AND RAMPS:

a. Runway or ramps shall not be less than 430 mm in width and constructed of not less than 25 mm thick planking or any other material of adequate strength to withstand the required load, supported substantially in relation to the span and braced with such runway or ramp, and design and construction of such runway or ramp shall be in accordance with the approved standards;

b. Every runway or ramp located more than 3 m above the floor or ground shall be on open sides and provided with a guardrail of adequate strength and height of not less than 1 m.

c. Use of runways and ramps by vehicles:

   i. All runways and ramps shall be of sound construction, strength and securely braced and supported;

   ii. Every runway or ramp for the use of transport equipment like trailers, trucks or heavier vehicles shall have a width of not less than 3.7 m and provide with timber curbs or any other material of adequate strength with not less than 200 mm by 200 mm in width placed parallel to, and secured to, the sided of such runway or ramp and such runways or ramps or ramps shall be designed in accordance with the approved standards.

9.2. SLOPE OF RAMPS:

Every ramp shall have a slope not exceeding one in four and the total rise of a continuous ramp used by building workers carrying material or using wheelbarrows shall not exceed 3.7 m, unless broken by horizontal landing of at least 1.2 m in length.

9.3. USE OF RUNWAYS OR RAMPS BY WHEELBARROWS, ETC.

a. Every runway or ramp used for wheelbarrows and carts or hand trucks shall not be less than 1 m width and constructed of not less than 50 mm thick planking, and supported and braced suitably for such use;

b. Every runway or ramp located more than 3 m above the floor or ground shall be provided on the open sides with suitable guardrails of adequate strength.

10. SAFETY IN HANDLING AND USE OF EXPLOSIVES

10.1 GENERAL PROVISIONS:

a. The use of explosives shall be carried out in a safe manner to avoid injury to any person and under the direct supervision of a responsible person;

b. No person other than authorized and competent one shall be allowed to handle and use explosives;

c. Before using any explosive, necessary warning and danger signals shall be erected, at conspicuous places of such use to warn the building workers and the general public of the danger involved in such use.

d. No person other than authorized and competent one shall be allowed to handle and use explosives.

e. Smoke, open lamps, other type of hot or heat producing items and sparks shall be prohibited in or near explosives magazines or while explosives are being handled, transported or used.

f. No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors or dangerous drugs.

g. The explosives shall be accounted for at all times. No explosives or blasting agents shall be abandoned.

h. No fire shall be fought where the fire is in the imminent danger of contact with explosives. All employees shall be removes to a safe area and the fire area shall be guarded against intruders.

i. Employees authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution including but not limited to visual and audible warning signals, flags, or barricades to ensure employee safety.

j. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity or otherwise. These precautions shall include:

k. Short-circuiting of detonators in holes, which have been primed and shunted until wired into the blasting circuit.

l. The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.

m. The prominent display of adequate signs, warning against the use of radio transmitters, on all roads within 1000 ft of blasting operations. Whenever adherence to the 1000 ft distance would create an operational handicap, a competent and expert person shall be consulted to evaluate the particular situation, and an alternative provided, which are adequately designed to prevent any premature firing of electric blasting of caps. A description of any such blasting shall be reduced to writing and shall be certified as meeting the purposes of this subdivision by the competent person consulted. The description shall be maintained at the construction site during the duration of the work, and shall be available for inspection.

n. Empty boxes and paper and fiber packing materials, which have previously contained high explosives, shall not be used again for any purpose, but shall be destroyed by burning at an approved location.

o. Explosives, blasting agents and blasting supplies that are obviously deteriorated or damaged shall not be used.

p. Delivery and issue of explosives shall only be made authorized persons into authorized magazines or approved temporary storage or handling areas.

q. Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the operators and/or owners have been notified and measures for safe control have been taken. In such situations controlled blasting shall be restored to.

r. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in this field.

s. Loaded boreholes shall not be left unattended after the end of the shift.

t. Suitable and sufficient means of egress to ground level shall be provided in all cases of excavations, trenches, all other places where explosives are handled above or below ground level.

u. At an appropriate time before the final blasting warnings, workers in the area shall be removed to a designated safe place.

v. An unmistakable, audible, final warning shall be sounded one minute prior to the detonation of explosives; after completion, when the person in charge has established that safe conditions prevail, an "all clear" shall be sounded.

w. To prevent persons entering any danger zone during blasting operations notices shall be given to all concerned.

x. Notices referred above shall indicate:

   i. that explosives are in use;

   ii. the audible warning sound and the "all clear" and state when they will be sounded; and

   iii. the warning flags in use, including an "all clear" flag.

y. Precautions against lightning shall be provided in accordance with the Indian Electricity Act and Indian Explosives Act and Rules and regulations framed there under.

z. Package containing explosives shall not be dragged, dropped or handled roughly.

aa. Non-sparking tools shall be used to open keys.

bb. The explosives shall not be carried in the box or otherwise on any individual.

cc. Nothing shall be inserted in the open end of the blasting cap except fuses.

dd. Deteriorated or damages explosives shall not be used but shall be disposed or destroyed strictly in accordance with the approved methods and in the doing so the manufacturers or the appropriate authority's instructions shall be followed.

ee. lightning shall be in accordance with Indian Electricity Act/Rules

10.2. TRANSPORTATION OF EXPLOSIVES

a. Keep safe distance and to use non-sparking tools while opening packages containing explosives;

b. Stop the use of explosives and handling thereof while the weather conditions are not suitable for such use or handling;

c. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power-lines, dust storms or other sources of extraneous electricity or otherwise. These precautions shall include –

   i. Suspension of all blasting operations and evacuation of persons;

   ii. All warning signs shall be displayed within 200 m of blasting operations and in case putting up a sign at 200 m is impractical, the contractor shall consult the Engineer-in-charge for alternatives;

   iii. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in the field;

   iv. To prevent persons entering any danger zone during blasting operations, notices shall be given to all concerned;

d. In addition to these provisions, all measures and precautions that are required to be observed for use, handling, storing or transportation of explosives under the Rules framed under the Explosives Act, 1884 (4 of 1884) shall be observed;

e. All the relevant statutory provisions, local laws and rules and regulations shall be complied with.

f. Where the magazine is located near the construction site and blasting operation continues daily, actual requirement of explosives shall be drawn from the magazine and transported to the site. Any leftovers shall be returned to the magazine each time after the blast. In case of work at scattered places and for a small duration, portable magazines shall be used and kept within a fence in safe place and properly guarded.

g. For carrying higher quantity (more than 5 kg of explosives) specially designed insulated containers shall be used. These containers shall be constructed of finished wood not less than 5cm thick or plastic not less than 6mm thick or pressed fibre not less than 10mm thick. There shall be no metal parts (not even nails, bolts, screws etc.) and the containers shall be provided with suitable non-conductive carrying device, such as rubber, leather or canvas handle or strap.

h. Vehicles to be used for transportation explosives shall be in good working condition and shall have a tight wooded or non-sparking metal (copper, brass and the like) floor with sides and

ends high enough to prevent the explosives from failing off the vehicle. In open bodied vehicles, the explosives shall be covered with a waterproof and fibre tarpaulin.

i. Electrical wiring in vehicle shall be fully insulated so as to prevent the danger of short-circuiting and at least two fire extinguishers of carbon dioxide type shall be carried. The vehicle shall be properly marked indicating adequate warning to the public in regard to the nature of cargo.

j. No metals except approved metal truck shall be allowed to come in contact with cases of explosives, metal, flammable, or corrosive substance shall not be transported with explosives. As far as possible, transportation of any material along with explosives shall be prohibited.

k. Smoking shall be prohibited in the vehicle carrying explosives.

l. No unauthorized person shall be allowed in the vehicle, carrying explosives.

m. Loading and unloading of explosives shall be done carefully.

n. Explosives and detonators or blasting caps shall not be permitted to be transported in the same vehicle.

o. Detonators and other explosives for blasting shall be transported to the site of work in the original containers or in securely locked separate non-metallic containers and shall not be carried loose or mixed with other materials.

10.3. STORAGE OF EXPLOSIVES AND BLASTING AGENTS

a. Explosives and related materials shall be stored in approved facilities.

b. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents.

c. Smoking and open flames shall not be permitted within 50 feet of explosives and detonators storage magazine.

d. No Explosives or blasting agents shall be permanently stored in any underground area until the area has been developed to the point where at lease two modes of exit have been provided.

e. Permanent underground storage magazine shall be at least 300 feet from any shaft or other active under ground working area.

f. Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents.

10.4. DRILLING AND LOADING

a. Before planning out the drilling operations for blasting purposes, nature of stratum and the over burden shall necessarily be examined to avoid possibilities of landslides after blasting.

b. The face or rock shall be carefully examined before drilling to determine the presence of unfired explosives**.** No attempt shall be made to drill at a site if un-detonated explosives are suspected. In such case the boreholes shall be thoroughly cleaned before a cartridge is

inserted. Wooden tamping rods (not pointed, but cylindrical throughout) shall be used in the charging the holes. The cartridge will be on the top.

c. The borehole shall be carefully checked for length, presence of water dust, etc. with a wooden temping pole or a measuring tape before loading.

d. Surplus explosives shall not be stacked near working areas during loading/unloading.

e. The line of detonating fuse extending into a borehole shall be cut from the spool before loading the remainder of the charge.

f. A bore shall not be loaded with explosives after springing (enlarging the hole with explosives) or upon completion of drilling without making sure it is cool and it does not contain any hot smoldering material. Temperatures in excess of 65° C are dangerous.

g. A bore near another hole loaded with explosives shall not be sprung.

h. No force shall be used for inserting cartridges or any explosives into a bore hold or pass any obstruction in a borehole.

i. No force shall be used for inserting a blasting cap or an electric blasting cap into explosive. The cap shall be inserted into a hole made with a pickers designed for the purpose. A hitch of the electric blasting cap leading wire shall be made on the primer cartridge so as to prevent pulling out the electric blasting cap from the explosive charge. In case of fuse, the fuse shall be tied to the explosive cartridge so that the blasting cap is not pulled out. Care shall be taken so that the blasting cap is not pulled out. Care shall be taken so that the electric blasting cap, leading wire or the length of the fuse does not get damaged during loading of the charge.

j. No attempt shall be made to slit, drop, deform or abuse the primer.

k. Blasting caps or electric blasting caps shall not be connected to detonating fuse except by methods recommended by the manufacturers of caps.

l. Explosive cartridge shall not be cut, nor explosive removed from the cartridge for use.

m. Metallic devices of any kind shall not be used in tamping. Wooden tamping tools with not exposed metal parts except non-sparking metal connectors for jointed poled shall be used. Violent tamping shall be avoided. Primer shall not be tamped.

n. Care shall be taken to confine the explosives in the bore hold with sand, earth clay or other suitable combustible stemming material.

o. Kinking or injuring of fuse or electric blasting cap wires shall be avoided when tamping.

10.5. ELECTRICAL SHOT-FIRING CIRCUIT

a. In deciding the sizes of wires, fuses, circuits, blasting switches, etc., instructions issued by the manufacturers of these articles shall be followed, if they do not contradict with Indian Explosives Act or framed under it.

b. No person shall attempt to uncoil the wires and open out the short-circuited bare leading wires of the electric blasting cap during approach of dust storm or near any source of large

charge of static electricity or near a radio transmitter. The manufacturer of the cap or the Inspectorate of Explosives shall be consulted regarding the distance from the transmitter beyond which electric short firing shall be conducted.

c. Firing circuit shall be kept completely insulated from the ground of the other conductors, such as wires, rails, pipes or other paths or stray current.

d. There shall not be any electric live wires or cables of any kind near electric blasting caps or other explosives except at the time and for the purpose of firing the blast.

e. All electric blasting caps shall be tested singly and also when connected in a circuit in series using only an approved type of circuit continuity tester or ohmmeter.

f. No attempt shall be made to use in the same circuit either electrical blasting caps made by more than one manufacturer or electric blasting caps of different design or function even if made by the same manufacturers unless such use is approved by the manufacturers.

g. No attempt shall be made to fire a circuit of electric blasting caps with less than the minimum current specified by the manufacturer of that electric blasting cap.

h. Care shall be taken to ensure that all wire ends to be connected are bright and clean.

i. The electric cap wires or leading wires shall be kept short circuited until ready to fire.

j. When energy for blasting is taken from power circuits the voltage shall not exceed 220v. The wiring controlling arrangements shall conform to the following:

k. The blasting switch shall be strictly according to the specifications, externally operated double-throw switch, which when locked in the open position will short circuit and ground the leading wires. The switch shall be installed at the location where the firing is to be controlled.

l. A 'safety' switch of the same type as the blasting switch shall be installed between the blasting switch and the firing circuit and lead lines, at a distance not to exceed 180cm from the blasting switch.

m. Both the safety switch and the blasting switch shall be locked in the open position immediately after the shot and before any person is permitted to return to the blasting area. Key to the switches shall remain in the possession of the blaster at all times.

n. Rubber covered or other adequately insulated copper wires in good condition shall be used for firing lines and shall have solid cores of appropriate gauge. Sufficient firing line shall be provided to permit the blaster to be located at a safe distance from the blast. Single conductor lead lines shall be used.

o. Blasting operations in the proximity of overhead power lines, communication lines, utility lines, or other structures shall not be carried on until the operator or the owner, or both of such lines as been notified and precautionary measures deemed necessary, have been taken.

p. All holes loaded on a shift shall be fired on the same shift.

q. As far as possible, blasting shall be carried out using suitable exploder with 25 per cent excess capacity. Electric power from the mains shall be used only when it is absolutely necessary.

10.6. SHOT-FIRING WITH SAFETY FUSE

a. The fuse shall be carefully handled to avoid damaging the covering. In very cold weather the fuse shall be slightly warmed before using so as to avoid cracking the waterproofing.

b. Short fuse shall not be used. The length of a fuse shall not be less than 120cm. The rate of burning of the fuse shall be known and it would be necessary to make sure that it will take sufficient time in burning so as to enable all persons to reach a place of safety. The burning rate of the fuse shall not be more than 60 cm/min.

c. The fuse shall not be cut until the operation to insert the fuse into a blasting cap is ready. The fuse shall be cut off about 2.5 to 5 cm to ensure a dry end. It shall be cut squarely across with a clean and sharp blade. The fuse shall be seated lightly against the cap charge and care shall be taken to avoid twisting after it has been placed in position.

d. Blasting caps shall not be crimped by any means except by a cap crimper designed for the purpose. It shall be necessary to make sure that the cap is squarely crimped to the face.

e. The fuse shall be lighted with a fuse lighter designed for the purpose. If a match is used, the fuse shall be slit at the end and the match head held in then slit against the power core and then the match head rubbed against an abrasive surface to light the fuse.

f. The fuse shall not be lighted until sufficient stemming has been placed over the explosives to prevent sparks of live match heads from coming into contact with the explosives.

g. The explosives shall not be held in hands when lighting the fuse.

10.7. UNDERGROUND WORK

a. Only permissible explosives and in the manner as specified by the appropriate authority shall be used.

b. Excessive quantities of explosives shall not be taken underground at any time. Black blasting powder or pellet powder shall not be used with any other explosive in the same borehole.

10.8. BEFORE AND AFTER FIRING

a. Before firing, sufficient warning shall be given to enable the people working in the area to get off the danger zone. The danger zone shall be suitable cordoned off and flag men posted at important points.

b. No loose materials, such as tools, drilling implements etc. Shall be left on the rock surfaces to be blasted.

c. Blasting in the open shall be carried out during the fixed hours every day or on fixed days in the week. This information shall be amply publicized and the following precautions observed:

d. On the project sites, where blasting operations are carried out, daily blasting hours shall be clearly printed on the sign-boards on all the roads approaching that area.

    i. Road closing barriers should be provided to close the traffic on these roads, at least 400 meters away when the firing is to take place.

ii. The beginning of the firing shall follow loud sirens and similarly loud sirens shall succeed the completion of the firing.

e. The shot-firer shall not be allowed to return to the blasting site after firing, until at least 5 min have elapsed. In case of electric shot firing, the shot holes shall be examined after firing and in case of misfire no person shall be allowed to approach the blasting site for at lease 5 min. In case of shot firing with safety fuse, utmost care shall be taken to count the number to ensure that all the shots have fired and in the event of misfire, no person shall be allowed to approach the blasting site for at least 30 min. In any case, a careful inspection for the remaining un-detonated explosive shall be made after firing the shots. All misfired shot holes shall be cross-marked. No other person than those duly authorized shall approach the holes until one of the following operations has been performed in respect of each of the misfired holes:

f. If the misfire is due to a faulty cable or faulty electrical connection the defect shall be remedied and the shot fired.

g. The stemming shall be floated out by use of water or air jet from hose until the hole has been opened to within 60 cm of the charge, whereupon water will be siphoned or pumped out, then a fresh new charge placed and duly detonated. Or

   i. A careful search shall be made of unexploded material in the debris of the charge.

   ii. If a shift charge is unavoidable, the person in-charge of one shift before leaving the work shall inform the person relieving him for the next shift of any cases misfired and shall point out their position duly cross marked and also state clearly what action has to be taken in the matter.

Note: The rules are made considering statutory provisions and other National/International standards. However, if any statutory provision overruling these laws is made, the statutory provisions shall overrule the NTPC Rules.

11.0 SAFETY IN EXCAVATION & TUNNELING WORK

SAFETY IN EXCAVATION

11.1GENERAL PROVISIONS

a. Before undertaking any activity, the soil shall be tested and in case of availability of any explosive gas, necessary arrangements must be made to remove/dilute such gases and in case they are found to be toxic or poisonous, the workplace must be purged and continuous ventilation maintaining the contamination below the permissible level ensured;

b. The position of underground installations such as sewers, water pipes and electrical cables shall be verified and in case of their existence, they must be isolated;

c. If they cannot be isolated or removed or shutdown, they shall be fenced, hung up or otherwise protected. On every part likely to be visited by persons or where transport vehicles ply, the area shall be suitably fenced, guarded or barricaded to prevent fall of persons, vehicles or livestock into the excavated area;

d. Warning signs shall be erected and the in the night hours the area shall be illuminated to warn pedestrians and vehicular traffic;

e. Arrangements shall be made to prevent external vibrations due to rail/road traffic;

f. Blasting shall be carried out in accordance with the norms applicable in this regard. Special care shall be taken to control the impact of vibrations/tremor caused by blasting to protect excavations from cave-ins;

g. Arrangements shall be made to save other buildings/structures in the affected zone or in the vicinity of the area of excavation, from collapse;

11.2 SHORING AND TIMBERING

a. Site of excavations, where workers are exposed to danger from moving ground, shall be made safe by maintaining due slope not exceeding the angle of repose of different types of soil or otherwise by shoring, portable shields or other effective means;

b. All trenches in the soil, other than rock or hard compact soil more than 1.5 m deep into which men enter, shall be securely shored and timbered under the supervision of a competent person and only the trained workers shall be allowed to substantially alter or dismantle the shoring or timbering;

c. All struts, braces and walls in excavation shall be adequately secured so as to prevent their accidental displacement;

d. In all excavations in soft or fissured rock or hard soil exceeding 2 m in depth, except those which are sloped to within 1.5 m of the bottom into which men enter, shall be securely shored and timbered;

e. Where the sides of the excavations are sloped as outlined above, but not within the 1.5 m of the bottom, vertical sides shall be shored and the shoring shall extend at least 30 cm above the vertical sides. When open spaced sheathing is used, a toe-board shall be provided to prevent material rolling down the slope and falling into the excavated.

11.3. SHEATHING

a. The sheathing should be placed against the side of the trench so that length of each piece of sheathing is vertical. It should be held securely in place against the wales by ensuring that sheathing is kept firmly pressed against the wall of the trench. Where the trench excavated is loose, sandy or soft soil or soil which has been previously excavated or soil which is under hydrostatic pressure, each piece of sheathing shall be driven into the bottom of the trench so as to firmly hold it in place;

b. Where two or more pieces of sheathing are used one above another, the sheathing shall be so arranged that the lower pieces of sheathing shall overlap the lowest wales supporting the piece of sheathing next above it. These pieces of sheathing shall be firmly driven into the soil and securely supported by wales and struts, as the trench is made deeper.

11.4. WALES

a. The wales shall be parallel to the bottom or the proposed bottom of the trench. Each wale shall be supported on cleats spiked to the sheathing or by posts set on the wales next below it and in the case of the lowest wale on the bottom of the trench itself. Where necessary, wedges may be provided between a wale and the sheathing it supports so that roughly uniformity is given to all individual pieces of sheathing.

11.5. STRUTS

a. Struts shall be horizontal and at right angles to the wales or sheathing supported thereby. Struts shall be cut to the proper length required to fit in tightly between the wales. Where necessary, the struts shall be held securely in place by wedges, driven between the struts and the wales;

b. Struts shall be placed on cleats spiked or bolted to the posts supporting the Wales.

11.6. LOOSE SITE MATERIALS:

No loose material shall be kept very close to the excavation creating possibility of its fall into the excavated area. A safe distance of at least 1 m shall be maintained.

11.7. PLANT & MACHINERY:

Movement of vehicles and heavy equipment shall be kept at a distance least equal to the depth of the excavation or at least 6 m for excavation deeper than 6 m and the workers shall be provided with proper tools.

11.8. MEANS OF ACCESS

a. For trenches deeper than 1.5 m, safe means of access and egress shall be provided at intervals of every 15 m. Where it is not possible to provide safe means of access and egress as above, ladders shall extend from the bottom of the trench to at least 90 cm above the ground;

b. Walkways, runways and sidewalks shall be kept clear of excavated materials or other obstructions and no side walls shall be undermined-undercut unless it is capable of carrying a minimum live load of 125 lbs per square feet;

c. If planks are used for raising walkways, runways or sidewalks, they should be parallel to the length of the walk and fastened together against displacement;

d. Lone worker shall not be allowed to work in the excavated area.

11.9. INSPECTIONS:

A competent person shall make inspections every day and necessary measures shall be taken to safeguard against possible cave-ins or slide or collapse of the excavations.

11.10. NOTIFICATION OF INTENTION TO CARRY OUT EXCAVATION AND TUNNELING WORK

a. Within thirty days, prior to the commencement of such excavation or tunneling work, the contractor shall inform in writing the detailed layout plans, method of construction and schedule of such excavation or tunneling work to the Engineer in-charge of NTPC;

b. In case compressed air is used in such excavation or tunneling work or any work incidental to or required for such excavation or tunneling work, the technical details and drawings of all man-locks and medical-locks together with names and addresses of all construction medical officers duly qualified and so appointed by such contractor for the purpose of such excavation or tunneling work shall be sent to the Engineer in-charge.

11.11. PROJECT ENGINEER

a. The contractor undertaking any excavation or tunneling work shall appoint a Project Engineer for safe operation of such projects;

b. Such Project Engineer shall exercise overall control of the operations and the activities at such project and be responsible for carrying out the activities safely.

11.12. RESPONSIBLE PERSON

a. The contractor undertaking excavation or tunnel ling work at construction site of a building or other construction work shall appoint a responsible person for safe operation of such excavation or tunneling work;

b. The name and addresses of such responsible persons shall be forwarded to the Engineer in-charge;

c. Duties and responsibilities of the responsible person referred to above person shall include

   i. To carry out smoothly such excavation or tunneling work;

   ii. To inspect and rectify any hazardous situation relating to such excavation or tunneling work;

   iii. To take remedial measures to avoid any unsafe practice or conditions relating to such excavation or tunneling work.

11.13. WARNING SIGNS AND NOTICES

a. Suitable warning signs or notices, required for the safety of building workers carrying out the work of an excavation or tunneling, shall be displayed or erected at conspicuous places in Hindi

and in language understood by the majority of such building workers at such excavation or tunneling work;

b. Such warning signs and notices with regard to compressed air working shall include:

   i) The danger involved in such compressed air work;

   ii) Fire and explosion hazards;

   iii) The emergency procedures for rescue from such danger or hazards.

11.14. REGISTER OF EMPLOYMENT

a. The contractor shall ensure that at a construction site of a building or other construction work where an excavation or tunneling work is being carried on, a register of employment of building workers carrying out such excavation or tunneling work is maintained and produced on demand;

b. Periods of work of such excavation or tunneling work shall be maintained in a register on day-to-day basis and such register shall be produced on demand

11.15. ILLUMINATION

a. All contractors carrying out excavation or tunneling work at a construction site of a building or other construction work shall provide for emergency generators on such construction site to ensure adequate illumination at all work places where such excavation or tunneling work is being carried out;

b. In case of power failure, all workplaces where excavation or tunneling works are carried out shall be adequately illuminated

11.16. PNEUMATIC TOOLS:

Supply lines to pneumatic tools used within a tunnel are fitted with water trap or safety chain or safety wire, as the case may be.

11.17. STABILITY OF STRUCTURE DURING GENERAL EXCAVATION & TUNNELING:

The contractor shall ensure that where there is any doubt as to the stability of any structure adjoining the workplace or other areas to be excavated or where tunneling work is to be carried out –

a. The Project Engineer shall arrange for measures like underpinning, sheet piling, shoring, bracing or other similar means to support such structure and to prevent injury to any building worker working adjacent to such structure or damage to property or equipment adjacent to such structure;

b. Where any building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 m above his footing, such worker shall be protected by adequate piling and bracing against such bank or side;

c. The excavation and its vicinity shall be checked by a responsible person after every rain, storm or other occurrences carrying hazards and in case a hazard is noticed at such checking, adequate protection against slides and cave-in to prevent such hazard shall be provided;

d. Temporary sheet piling installed for the construction of a retaining wall after excavation shall not be removed, except on the advice of the responsible person after an inspection carried out by such responsible person;

e. Where banks of an excavation are undercut, adequate shoring shall be provided to support the material or article overhanging such bank;

f. Excavated material shall not be stored at least 0.5 m from the edge of an open excavation or trench and the banks of such excavation or trench shall be stripped of loose rocks and other materials which may slide, roll or fall upon a building worker working below such bank;

g. Adequate and suitable warning signs shall be put-up at conspicuous places at the excavation work to avoid any person falling into the excavations or trenches;

h. The responsible person shall ensure at the excavation that no building worker is permitted to work where such building worker may be struck or endangered by the excavation machinery or material or article used in such excavation.

11.18. SAFE ACCESS AND EGRESS:

Ladders, staircases or ramps are provided, as the case may be, for safe access to and egress form excavation where the depth of such excavation exceeds one point 1.5 m and such ladders, staircases or ramps comply with the relevant national standards.

11.19. TRENCHES

a. A trench or excavation shall be protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection shall be an improved protection in accordance with the design and drawing of a Professional Engineer, where such depth exceeds 4 m;

b. Where the depth of a trench requires two lengths of sheet piling, one above the other, the lower piling shall be set inside the bottom strings or wales of the upper piling and such sheet piling shall be driven down and braced as the excavation continues;

c. All metal sheet piles used in excavation or a trench shall be welded end-to-end and secured by other similar means.

11.20. POSITIONING AND USE OF MACHINERY:

Any machinery used in excavation and tunneling work shall be positioned and operated in such a way that such machinery will not endanger the operator of such machinery or any other person in the vicinity.

11.21. BREATHING APPARATUS:

Suitable breathing apparatus shall be provided to a building worker while working in compressed air environment for his use at excavation or tunneling work and such breathing apparatus shall be maintained in good working condition at all times.

11.22. SAFETY MEASURES FOR TUNNELING OPERATIONS

a. Where there is a danger of falling or sliding of material from the roof face or wall of a tunnel, adequate measures such as shoring, supporting by means of rock bolts, segments or steel sets shall be taken for the safety of building workers;

b. The excavated areas shall be made safe by use of suitably designed and installed steel sets, rock bolts or similar other safe means;

c. The responsible person shall examine and inspect the workplaces in a tunnel before the commencement of work in such tunnel and at regular intervals thereafter to ensure safety of the building workers in such tunnel;

d. The portal areas of a tunnel with loose soil or rock, likely to cause injury to a person shall be adequately protected with supports.

11.23. SURROUNDINGS OF A SHAFT

a. Surroundings of a shaft used in excavation or tunnel work shall be protected from being washed away by construction of sufficient height;

b. Where a building worker is required to enter a shaft at an excavation or tunneling work, safe means of access shall be provided for such entry;

c. Every shaft at excavation or tunneling work shall be provided with a steel casing, concrete piping, timber shoring or other materials of adequate strength for the safety of building workers working in such shaft;

d. Such casing and bracing shall be provided to shafts at an excavation or tunneling work according to the appropriate design for such casing and bracing;

e. A reinforced concrete raft and beam shall be provided around the opening of a shaft at an excavation or tunneling work if the ground surrounding such opening is unstable or unsafe.

11.24. LIFT FOR SHAFT:

Lift shall be provided for transport of building workers and materials or articles at an excavation or tunneling work required to descend more than 50 m in a shaft.

11.25. MEANS OF COMMUNICATION

Reliable and effective means of communication such as telephone or walkie-talkie shall be provided and maintained in working order for arranging better and effective communication at an excavation or tunneling work at the following locations, namely:

i. Working chamber of an excavation;

ii. Intervals of hundred meters along the tunnel;

iii. Working chamber side of a man lock near the door of such man lock;

iv. Interior or each chamber of a man lock;

v. Location conspicuous lock attendant's situation;

vi. A compressor plant;

vii. A first-aid station, and

viii. Outside the portal or the top of a shaft;

ix. Such number of bells and whistles shall be made available at all times at the locations as are necessary for the safety of persons at such locations.

11.26. SIGNALS:

The standard audio or video signals shall be used in excavation or tunneling work and conspicuously located or displayed near entrance to the workplace and in such other locations as may be necessary to bring such signals to notice of all building workers employed in such excavation or tunneling work.

11.27. CLEARANCES

a. The minimum lateral clearances of 0.5 m shall be maintained between any part of a vehicle and any fixture or any equipment used in an excavation or tunneling work after allowing the throw or swing of such fixture or equipment;

b. The overhead clearance for a locomotive drive at excavation or tunneling work shall not be less than 1.20 m above the seat of such driver and not less than 2 m above the platform where such driver stands or of any other dimension in accordance with the approved standard.

11.28. SHELTERS:

The adequate number of shelters for the safeguard of the building workers are provided where, in the course of working, they are liable to be struck by a moving vehicle or other material handling equipment in a tunnel.

11.29. USE OF INTERNAL COMBUSTION ENGINE:

No internal combustion engine shall be used underground in excavation or tunneling work unless such engine is so constructed that the air entering the engine gets cleared before entry and the engine emits no fumes or sparks.

11.30.INFLAMMABLE OILS:

Inflammable oils with the flash point below the working temperature that is likely to be encountered in a tunnel shall not be used in excavation or tunneling work.

11.31. COUPLING AND HOSES:

All high-pressure hydraulic hoses and couplings shall be adequately protected against any possible damage in excavation or tunneling work.

11.32. HOSE INSTALLATION:

All hydraulic lines and plants working at a temperature exceeding 750 c shall be protected by adequate insulation or otherwise against accidental human contact in excavation or tunneling work.

11.33. FIRE RESISTANT HOSES:

No fire hydraulic hoses other than fire resistant hydraulic hoses are used when hydraulically activated machinery and equipment are employed in tunnels.

11.34. FLAMEPROOF EQUIPMENT:

Only flameproof equipment of appropriate type as per approved standards shall be used where there is a danger of flammable or explosive atmosphere being prevalent inside the tunnel.

11.35. STORING OF OIL AND FUEL UNDERGROUND:

All oils, greases or fuels stored underground in excavation or tunneling work shall be kept in tightly sealed containers and in fire resistant areas at safe distances away from explosive and other flammable chemical and appropriate flameproof installation shall be used in such storage areas.

11.36. USE OF GASES UNDERGROUND

a. Petrol or liquefied petroleum gas or any other flammable substances shall not be used or stored inside the tunnel except with the prior approval of the Project Engineer;

b. After the use of the petroleum or liquefied petroleum gas, or highly inflammable substances, all remaining petroleum or liquefied petroleum gas or highly inflammable substances shall be removed immediately from such tunnel;

c. No oxy-acetylene gas shall be used in a compressed air environment in excavation or tunneling work.

11.37. WATER FOR FIRE FIGHTING

a. Adequate number of water outlets shall be provided on excavation or tunneling work and readily made accessible throughout the tunnel for fire fighting purposes and such water outlets shall be maintained for effective fire lighting;

b. All air locks shall be equipped with fire fighting facilities at excavation or tunneling work;

c. An audible fire alarm shall be provided to warn the building workers whenever a fire breaks out on an excavation or tunneling work;

d. Adequate number and types of fire extinguishers, in accordance with relevant national standards, shall be provided and made readily available to fight any outbreak of fire at an excavation or tunneling work;

e. Fire extinguishers with vaporizing liquids and high pressure carbon dioxide shall not be used in tunnels or other confined spaces;

f. The instructions regarding steps to be followed to fight outbreak of fire, at an excavation or tunneling work, written in Hindi or local language understood by the majority of the building workers employed on such excavation or tunneling work, shall be displayed at conspicuous and vulnerable places of such excavation or tunneling work.

11.38. FLOODING

a. Water tight bulkhead doors shall be installed at the entrance of a tunnel to prevent flooding during a tunneling work where more than one tunnel is driven from a shaft;

b. All necessary measures shall be taken to ensure that no building worker is trapped in any isolated section of a tunnel when any bulkhead door of such tunnel is closed;

c. Where there is likelihood of flooding or water rushing into a tunnel during a tunneling work, arrangements shall be made for immediate starting of water pumps to take out water of such flooding or water rushing and for giving alert signals to the building workers and other persons to keep them away from danger.

d. Airtight steel curtains shall be provided in areas liable to flooding at tunneling work and in case of descending tunnels, such curtains shall be provided in the top half of such tunnels to ensure the retention of pockets of air for rescue purpose.

11.39. REST SHELTERS

a. Where building workers employed in a compressed air environment in a tunneling work are required to remain at the work site for one hour or more after de-compression from pressure exceeding one bar, adequate and suitable facilities shall be provided for such building workers to rest;

    a. Every man-lock, medical-lock and any other facility inside these locks in a tunneling work shall be maintained in a clean state and in good repairs;

    b. A first-aid room shall be provided and readily available at a construction site of a tunneling work;

    c. Each man-lock attendant at the station shall be provided with a first-aid box.

11.40. PERMISSIBLE LIMIT OF EXPOSURE OF CHEMICALS

a. The working environment in a tunnel or a shaft in which building workers are employed shall not contain any of the hazardous substances in concentrations beyond the permissible limits;

b. The responsible person referred to shall conduct necessary test before the commencement of a tunneling work for the day and at suitable intervals as fixed by the Engineer in-charge, to ensure that the permissible limits of exposure are not exceeded and a record of such test shall be maintained and made available for inspection.

11.41. VENTILATION:

All working areas in a free air tunnel shall be provided with the approved ventilation system and the fresh air supplied in such tunnel shall not be less than 6 m^3 per minute for each building worker employed underground in such tunnel and the free air-flow movement inside such tunnel not less than 9 m^3 per minute.

11.42. AIR SUPPLY INTAKE POINT:

The air intake points for all air compression shall be located at places where such intake air does not get contaminated with dust, fumes, vapor and exhaust gases or other contaminants.

11.43. EMERGENCY GENERATORS

a. Every compressed air system in a tunnel shall be provided with emergency power supply system for maintaining continued supply of compressed air in such compressed air system, which shall be capable of operating air compressor and ancillary systems of such compressed air system;

b. The emergency power supply system shall be maintained and made readily available at all times.

11.45. AIR MAINS:

Every air-main supplying air to the working chamber, man-lock or medical-lock used at an excavation or tunneling work shall be protected against accidental damage and where it is not practicable to provide such protection, a stand-by air-main shall be provided.

11.46. BULKHEAD AND AIR LOCKS

a. A bulk head or air tight diaphragms retaining compressed air, when used within a tunnel or a shaft, shall be constructed to withstand the maximum pressure at 1.25 the maximum working pressure of such bulk head or diaphragm and such bulk head or diaphragm shall be tested before its each use by a responsible person to ensure that such bulk head or diaphragm is in proper working order;

b. Such responsible person shall keep the record of each test and such record shall be produced for inspection.

c. The bulk head or diaphragm shall be made of sound material of adequate strength, which shall be able to withstand the maximum pressure on which they are subjected to at any time of their use;

d. A bulkhead anchorage and air lick shall be tested at its work place at an excavation or tunneling work immediately after their installation at such place.

11.47. DIAPHRAGM:

All diaphragms, which are in the form of horizontal decks across a shaft used at excavation or tunneling work, shall be securely anchored

11.48.PORTABLE ELECTRICAL HAND TOOLS:

All portable electrical hand tools and inspection lamps used underground or in a confined space shall be operated at a voltage not exceeding 24 V.

11.49. CIRCUIT BREAKER

a. Adequate numbers of differential ground fault circuit breakers shall be installed for every electrical distribution system and its sub-systems used at an excavation or tunneling;

b. Work and the sensitivity of each of circuit breaker shall be adjusted in accordance with the requirement set out in accordance with the approved standards;

c. No semi-enclosed fuse unit shall be used in underground place.

11.50. TRANSFORMER:

The contractor shall ensure no transformer is used in any section of a tunnel under compressed air unless such transformer is of the dry type and conforms to the approved standards.

11.51. LIVE WIRES:

There shall be no exposed live wire in working areas at an excavation or tunneling work which are accessible to building workers other than those authorized to work on such live lines.

11.52. WELDING SETS:

All welding sets used in a tunnel shall be of adequate capacity and of suitable type, duly approved.

11.53. QUALITY AND QUANTITY

a. Every working chamber at an excavation or tunneling work where compressed air is used, the supply of such air shall be maintained at not less than 0.3 m^3 per minute per person working therein;

b. A reserve supply of compressed air shall be made available at all times for man-locks and medical locks used at a tunneling work;

c. The air supplied in a compressed air environment at a tunneling work shall be, as far as practicable, free from contaminants, namely, dust, fumes and other toxic substances.

11.54. WORKING TEMPERATURE:

The temperature in any working chamber at an excavation or tunneling work where building workers are employed shall not exceed 29^0 c and the arrangement shall be maintained for kipping records in which the temperatures measured by dry bulb and wet bulb inside such working chamber once in every hour and for producing such records for inspection on demand.

11.55. MAN-LOCKS AND WORKING IN COMPRESSED AIR ENVIRONMENT

a. Man-locks used at a tunneling work shall be of adequate strength, made of sound material and designed to withstand any pressure, internal or external, to which it may be subjected in the normal use or in an emergency;

b. Doors of man-locks at an excavation or tunneling work shall be made of steel and used at a tunneling work for keeping the work airtight and devices shall be provided for sealing the doors when such locks are under pressure. The anchorage of a man-lock used at tunneling work shall have adequate strength to withstand the pressure exerted by air on the man-lock. There shall be adequate room available for the workers for working in the man-locks;

c. Where work is carried out in any compressed air tunnel, a Man-lock in accordance with the approved standards shall be used;

d. Where a man-lock is used, safety Instructions in Hindi and in local language understood by majority of building workers employed there, shall be displaced at conspicuous places;

e. Except in an emergency, compression and de-compression operations shall be carried out in a man-lock and in an emergency any material-lock may be used;

f. A record of compression and de-compression shall be kept in writing and produced for inspection on demand;

g. Material lock shall be used with the permission of the Engineer in-charge where it is impracticable to install both the man-lock and the material-lock at;

h. The man-lock at tunneling work shall not be used for any purpose

i. other than compression or de-compression of building workers;

j. No de-canting of building workers at tunneling work shall be carried

k. out without prior approval of the Engineer in-charge except in an emergency;

l. In case a building worker collapses or is taken ill during his de-compression in a man-lock, the lock attendant of such man-lock shall raise the pressure to a level equal to the maximum pressure which that building worker was exposed to in the working chamber prior to such de-compression and such lock attendant shall immediately report the matter relating to such collapse to the medical lock attendant and medical officer on duty;

m. A building worker who had previously received training with a trained building worker to work in a compressed air environment at tunneling work shall be employed to work independently in such a compressed air environment;

n. A building worker who had undergone three de-compressions from a pressure exceeding one bar in a period of eight hours at tunneling work shall not be allowed to enter a compressed air environment except for the purpose of carrying out rescue work;

o. A building worker employed in a compressed air environment for a period of eight hours in a day at tunneling work shall not be employed again in such environment unless he has spent not less than twelve consecutive hours of rest at atmospheric pressure;

p. No building worker shall be engaged in a compressed air environment at a pressure, which exceeds three bars at a tunneling work unless prior permission, in writing, has been obtained from the Engineer in-charge;

q. No building worker shall be employed in a compressed air environment for more than fourteen consecutive days in a month;

r. A register of employment of all building workers in compressed air environment shall be maintained;

s. An identification badge shall be supplied to a building worker employed in compressed air environment;

t. The badge of a building worker shall contain particulars of his name, location of the medical-lock allotted to him for work, the telephone number of the Construction Medical Officer concerned for his treatment and the instructions in case of his illness of unknown and doubtful causes;

u. Record of all identification badges supplied to building shall be kept in a register;

v. Every building worker whose name appears in the register shall wear the badge supplied to him at all times during his duty hours;

w. Suitable warning signs shall be displayed in the compressed air for the prohibition of the following, namely:

    i) Use of alcoholic drinks;

    ii) Use and carrying of lighters, matches or other sources of ignition;

    iii) Smoking; and

iv) No entry to person who has consumed alcoholic drink

11.56.SAFETY INSTRUCTION:

All building workers employed in compressed air environment at tunneling work shall follow the instructions issued for their safety in the course of such employment.

11.57.MEDICAL-LOCK

a. A suitably constructed medical lock shall be maintained at tunneling work where building workers are employed in a working chamber at a pressure exceeding one bar;

b. Where more than one hundred building workers are employed in a compressed air working environment exceeding one bar at tunneling work, one medical-lock is provided for every one hundred building workers or part thereof and such medical lock shall be situated as near as possible to the main-lock used at such tunneling work.

12.0. SAFETY IN PILING WORK

12.1. GENERAL PROVISIONS

a. All pile driving equipment shall be of good design and sound construction, taking into account the ergonomic principles and properly maintained;

b. A pile driver shall be firmly supported on a heavy timber sill, concrete bed or other secured foundation;

c. In case a pile driver is required to be erected in dangerous proximity to an electrical conductor, all necessary precautions shall be taken to ensure safety;

d. The hoses of steam and air hammer shall be securely lashed to such hammer so as to prevent them from whipping in case of connection or break;

e. Adequate precaution shall be taken to prevent the pile driver from over turning and hammer from missing the pile;

f. A responsible person for inspecting pile-driving equipment shall inspect such equipment before taking it into use and takes all appropriate measures as required for the safety of building workers before commencing piling work by such equipment;

g. Where there is any question of stability of a structure for its adjoining areas to be piled, such structure shall be supported, where necessary, by underpinning, sheet pilling, shoring, and bracing or by other means to ensure safety and stability of such structure and to prevent injury to any person.

12.2. PROTECTION OF OPERATOR:

The operator of every pile driving equipment shall be protected from falling objects, steam, cinders or water by substantially covering or otherwise or by other means.

12.3. INSTRUCTION TO AND SUPERVISION OF BUILDING WORKERS WORKING ON PILE-DRIVING EQUIPMENT:

Every building worker working on a pile driving equipment shall be given instructions regarding safe work procedure to be followed in piling operation and shall be supervised by a responsible person throughout such work.

12.4. ENTRY OF UNAUTHORIZED PERSON:

The contractor shall ensure at a construction site of a buildings or other construction work that all piling areas where pile-driving equipment is in use are effectively cordoned off to prevent entry of unauthorized persons.

12.5. INSPECTION AND MAINTENANCE OF PILE DRIVING EQUIPMENT

a. Pile-driving equipment shall not be taken into use until it has been inspected by a responsible person and found to be safe for such use;

b. A responsible person for such inspection at suitable intervals to ensure safety to the building worker working on such equipment shall inspect pile driving equipment in use;

c. All pile lines and pulley blocks shall be inspected by a responsible person before the beginning of each shift of piling operations.

12.6. OPERATION OF PILE-DRIVING EQUIPMENT

a. Only experienced and trained building worker shall operate pile driving so as to avoid any probable danger from such operation;

b. Pile-driving operations shall be governed generally prevalent and accepted signals so as to prevent any probable danger from such operations;

c. Every building worker employed in pile driving operation or in the vicinity of such pile driving operation shall wear ear protection and safety helmet or hardhat and safety shoes;

d. Piles shall be prepared at a distance, at least equal to twice the length of the longest pile, from the place of pile-driving operations;

e. When a pile driver is not in use, the hammer of such pile driver shall be blocked at the bottom of the heads of such pile driver.

12.7. WORKING PLATFORM ON PILING FRAMES:

Where a structural tower supports the lead of a pile driver, leads at which it is necessary for the building workers to work and such platforms except on the hammer of such pile driver or lead sides of such platform and where such platforms cannot be provided with such railing and toe boards, a safety belt shall be provided to each such building worker.

12.8. PILE TESTING

a. The testing of pile shall be conducted under the supervision of a responsible person for such testing;

b. All practicable measures like displaying of waning notices, barricading the area and other similar measures shall be taken to protect the area where the pile testing is carried out;

c. Entry to a pile testing area shall be prohibited to general public to ensure safety.

12.9. PILING, SHORING AND BRACING

a. Planks used for sheet piling in excavation or tunneling work shall be of sound material with adequate strength;

b. Shores and braces used in excavation or tunneling work shall be of adequate dimensions and so placed as to be effective for their intended purposes;

c. Earth supported shores or braces used in excavation or tunneling work shall bear against a footing of sufficient area and stability to prevent the shifting of such shores or braces.

13.0. SAFETY IN THE ERECTION, USE AND DISMANTLING OF SCAFFOLDS

13.1. SCAFFOLD CONSTRUCTION

a. Every scaffold and every component thereof shall be of adequate construction, made of sound material and free from defects and safe for the purposes for which it is intended for use;

b. In case bamboo is used for scaffolding, such bamboo shall be of suitable quality, good condition, free from protruding knots and stripped off to avoid any injury to building workers during handling such bamboo;

c. All metal scaffolds used in building or other construction work shall conform to the approved standards;

13.2. SUPERVISION BY A RESPONSIBLE PERSON: No scaffold shall be erected, added, altered or dismantled except under the supervision of a responsible person.

13.3. Maintenance

a. The scaffold used in building or other construction work shall be maintained in good repairs and the measures taken against its accidental displacement or any other hazard;

b. No scaffold or part thereof shall be partly dismantled and allowed to remain in such a condition unless –

i) The stability or safety of the remaining portion of such scaffold has been ensured by a responsible person for the safety of such scaffolds;

ii) In case the remaining part of such scaffold cannot be used by the building workers, necessary warning notice written in Hindi and in a language understood by the majority of the building workers that such scaffold is unfit for use, shall be displayed at the place where such scaffold is erected.

13.4. STANDARDS, LEDGERS, PUTLOGS

a. Standards of a scaffold shall be plumb, where practicable, fixed sufficiently close together to secure the stability of such scaffold having regard to all the possible working situations and conditions for the intended use of such scaffold, spaced, as close as practicable, to ensure safety and stability of such scaffold;

b. Adequate measures are taken to, prevent displacement of a standard of a scaffold either by providing sole plate or a base plate, as necessary;

c. Ledgers of metal scaffold are placed at vertical intervals with due regard to safety and stability of such scaffold;

d. Bamboo ledgers are kept as nearly as possible and are placed and fastened to the standards of a scaffold with due regard to the stability of such scaffold.

13.5. WORKING PLATFORM

a. Working platform shall be provided around the face or edge of a building adjoining at every upper most permanent floor of such building under construction and at any level where construction work of such building is carried out;

b. A platform shall be designed to suit the number of building workers to be employed on each bay of a scaffold work on such platform and the materials or articles and tools to be carried with them in such bay;

c. The safe working load and the number of building workers to be employed in each bay of a scaffold shall be displayed for the information of all the building workers employed at such construction site.

13.6. BOARD, PLANK AND DECKING

a. Board, plank and decking used in the construction of a working platform shall be of uniform size and strength and shall be capable of supporting the load and number of building workers keeping in view the safety of such building workers;

b. Metal decking, which forms part of a working platform, shall be provided with non-skid surface;

c. No board or plank which forms the working platform shall be projected beyond its end support unless it is effectively prevented from tripping or lifting and board, plank or decking shall be fastened and secured;

d. At any one time, not more than two working platforms per bay, shall be used to support building workers or materials or articles at such bay;

e. Adequate measures shall be taken to prevent injury which may be caused by falling material and objects by using safety nets or other suitable means;

f. Concrete, other debris or materials shall not be allowed to accumulate at any platform on a scaffold;

g. Where a work is to be done at the end of a wall, working platform at such workplace shall be faced or, wherever practicable, at least 0.6 m beyond the end of such wall.

13.7. REPAIR OF DAMAGED SCAFFOLD

a. No building worker shall be permitted to work on a scaffold that has been damaged or wakened unless adequate safety measures have been taken to ensure the safety of such building worker;

b. Necessary warning signs shall be displayed at such places where repairs of scaffold are undertaken.

13.8. OPENING

a. There shall be no opening in any working platform except for allowing access to such working platform;

b. Wherever opening on a platform is unavoidable, necessary measures for protection against failing of objects or building workers from such platform shall be taken by providing suitable safety nets, belts or any other similar means;

c. Access from one working platform to another platform on a scaffold, if required, shall be provided with suitable and safe ladder for the use of building workers working on such platforms;

d. Every opening or shaft in the floor shall be provided with suitable means to protect the fall of a person or material by providing suitable fencing or railing of height not less than 900 mm.

13.9. GUARDRAILS: Every side of a working platform from which a person is liable to fall shall be provided with suitable and safe guardrails and toe board of adequate strength to prevent fall of any building worker, material or tools from such platform.

13.10. SCAFFOLD USED BY BUILDING WORKERS OF DIFFERENT EMPLOYERS

a. Where a scaffold or a part of a scaffold is used, which has previously been used by another employer for his building workers, such scaffold or part thereof shall be used only after its inspection and examination by a responsible person for ensuring that such scaffold or part thereof is safe and fit for such use;

b. If any rectification, alteration or modification in a scaffold or part thereof, needed to suit its use, shall be made in consultation with the responsible person.

13.11. PROTECTION AGAINST ELECTRIC POWER LINE:

The contractor shall ensure that all necessary and practical measures for protection are taken to prevent any building worker, working on a scaffold, from coming into contact with the electric wires or dangerous equipment.

13.12. SCREENING NET AND WIRE NETS:

Where a scaffold is erected in an area where the construction activities may pose hazards to pedestrians or vehicular traffic nearby from the falling of objects, wire nets or screening nets shall be used to envelope such scaffold.

13.13. TOWER SCAFFOLD

a. The height of every tower scaffold used in building or other construction work shall not be more than eight times the lesser to the base dimension of such scaffold;

b. A tower scaffold shall be lashed to a building or a fixed structure before being used by the building workers;

c. Any tower scaffold which can be moved or castered shall be –

i) Constructed with due regard to the stability and, if necessary, adequately weighted at the base;

ii) Used only on plain and even surface; and

iii) Has casters provided with positive locking devices to hold such scaffold in position;

d. No building worker shall remain on board scaffold or leave behind tools and material when it is being shifted from one position to another position.

13.14. GEAR FOR SUSPENSION OF SCAFFOLD

a. Chains, ropes or lifting gears used for suspension of a scaffold shall be of adequate strength, made of sound material and suitable for the purpose of their use and maintained in good repairs;

b. Chains, wires, ropes or metal tubes used for the suspension of a scaffold shall be:

i) Properly and securely fastened to every anchorage point and to the scaffold ledgers of other main supporting members used for the support of such scaffold; and

ii) So positioned as to ensure stability of the scaffold.

13.15. TRESTLE SCAFFOLD AND CANTILEVER SCAFFOLD

a. No trestle scaffold shall be constructed with more than three tiers or if its working platform is more than 4.5 m above the ground or floor or other surface upon which such scaffold is erected;

b. Trestle scaffold shall be designed by professional engineer and shall have the approval of the Engineer in-charge before being taken into use.

c. No trestle scaffold shall be erected on a suspended scaffold;

d. No cantilever or jib scaffold shall be used unless it is adequately supported, fixed and anchored on opposite side of its support and have out triggers of adequate length and, where necessary sufficiently, supported and braced to ensure safety and stability of such scaffold;

e. No working platform resting on bearers let into a wall at one end and without other support shall be used unless such bearers are of adequate strength, braced through the wall and securely fastened on the other side.

13.16. SCAFFOLD SUPPORTED BY BUILDING

a. No part of a building shall be used as support or part of a scaffold unless such part of the building is made of sufficient strength and made of sound material to afford safe support;

b. Overhanging eaves gutters shall not be used for supporting scaffold;

c. Suspended scaffold shall be made of in accordance with the approved standards before being used by the building workers.

13.17. USE OF WINCHES AND CLIMBERS FOR SUSPENDED SCAFFOLD

a. No scaffold shall be raised or lowered by winches or climbers unless such scaffold is made of sound material, adequate strength and has been tested and certified safe for use of winches or climber by a competent person before being taken into use;

b. All suspended scaffolds counter-balanced by counter weights shall be of approved types before being taken into use for building or other construction work;

c. The working platform of a suspended scaffold shall be securely fastened to the building or structure as to be safe and to prevent such platform from swing;

d. The safe working load that a suspended scaffold can carry, shall be displayed where such scaffold is being used

13.18. SAFETY DEVICES FOR SUSPENDED SCAFFOLD

a. Every suspended scaffold, raised or lowered by the winches or climbers, shall be provided at each of its suspension point with a safety rope with automatic safety device mounted on each of such rope so that such safety rope with such automatic safety device support the platform of such

scaffold in the event of failure of the primary suspension wire ropes, winches, climbers or any part of the mechanism used for raising or lowering such suspended scaffold;

b. Provided that the clause (a) shall not apply -

i) Where the platform of such scaffold is supported at two independent suspension wire rope at or near each end of such platform so that in the event of failure of one of such suspension wire rope, the other wire rope is capable of sustaining the weights of such platform and its load and prevent it from tilting; or

ii) Where a system is incorporated which operates automatically to support the platform of such scaffold and its load in the event of failure of the primary suspension wire rope of such scaffold.

14.0. SAFETY IN THE ERECTION OF STRUCTURAL FRAME & FORMWORK

14.1. GENERAL PROVISION

a. The trained building worker under the direct supervision of a person, responsible for structural frame and formwork, shall be employed for erection of such structural frame or formwork, dismantling of building and structure and performance of and engineering work formwork, false work and shoring work;

b. Adequate measures shall be taken to guard against hazards arising from any temporary state of weakness or unsuitability of a structure.

14.2. FORMWORK, FALSE WORK AND SHORING

a. Formwork and false work shall be so designed, constructed and maintained that such formwork and false work are able to support the load that may be imposed on them;

b. Such formwork shall be so erected that working platform, means of access, bracings, means of handling and stabilizing could easily be fixed with such formwork.

14.3. ERECTION OR DISMANTLING OF STEEL AND PREFABRICATED

a. Erection or dismantling of any pre-fabricated structure shall be made safe against danger by using appropriate means such as ladders, gangways or fixed platforms, buckets, boatswains chair or other appropriate means suspended from lifting appliances, safety harness, life lines, catch nets or catch platforms, power-operated mobile working platforms etc.;

b. The work of erection or dismantling of buildings or structures or formwork or false work or shoring or any other civil engineering work shall be carried out by trained building workers under the supervision of a person responsible for such work;

c. Steel or prefabricated structures shall be so designed and made that such structures can be safely transported or erected; and weight of each unit of such structures shall be clearly marked on such unit;

d. The design of each such part shall maintain stability of each part of the structures referred to in clauses above when erected, and to prevent danger, the design shall explicitly take into account –

   i) The relevant conditions and methods of attachment in the operations of stripping, transport, storing and temporary support during erection of such parts;

   ii) Safeguards, such as provision of railings with working platforms, and for mounting such railings and platforms easily on the structural steel or prefabricated parts;

e. The hooks and softer devices built in or provided on the structural steel or prefabricate parts that are required for lifting and transporting such parts shall be so shaped, dimensioned and positioned to withstand the stresses to which such hooks or other devices are subjected;

f. Prefabricated parts made of concrete shall not stripped or erected before such concrete has set and hardened sufficiently to the extent provided for in the plans, and such parts are examined by the responsible person for any sign of damage before their use;

g. Store-places shall be so constructed that –

   i) There shall be no risk of structural steel of prefabricated parts falling or overturning;

   ii) Storage conditions shall generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions; and

   iii) Racks shall be set on firm ground and designed so that units cannot move accidentally in such store-places;

h. Structural steel or pre-fabricated parts shall not be subjected to stresses prejudicial to their stability while they are stored or transported or raised or set down;

i. Tongs, clamps and other appliances for lifting structural steel and prefabricated part shall be:

   i) In such shape and dimensions as to ensure a secure grip without damaging and marked with the maximum permissible load in the most unfavourable lifting conditions; and

   ii) Structural steel or pre-fabricated parts shall be lifted by such methods and appliances that prevent them from spinning accidentally;

j. Structural steel or pre-fabricated parts shall be provided with railings and working platforms before raising such parts to prevent any danger of falling of building workers, materials or articles at the time of any work with such parts;

k. All reasonably practical measures shall be taken to avoid injury to building workers, building structure or equipment while structural steel or pre-fabricated parts are handled or stored or transported or raised or lowered;

l. Structures shall not be worked on during violent storms or high winds or any other such hazardous situation;

m. The risk of falling to which building workers, moving on high or sloping girders, may be exposed is limited by all means of adequate collective protection or by the use of a safety harness which shall be well secured to a sufficiently strong supports;

n. Structural steel parts, which are to be erected at a great height, shall, as far as practicable, be assembled on the ground;

o. When structural steel or pre-fabricated parts are being erected, a sufficiently extended area underneath the workplace shall be barricaded or guarded;

p. Steel trusses, which are being erected, shall be adequately shored, braced or guyed until they are permanently secured in position;

q. Structural members shall not be forced into place by the hoisting machine while any building worker is in such a position that he is likely to be injured by such operation.

14.4. FORMWORK

a. All formwork shall be properly designed keeping in view the safety of building workers, buildings or structures;

b. A responsible person for structural frame and formwork shall –

   i. Inspect and examine the material, timber, structural steel and scaffolding for its strength and suitability before being taken into use;

   ii. Lay-down procedures to cover all stages of such structural frame and formwork;

   iii. Supervise such structural frame and formwork;

   iv. Take all necessary steps or measure to correct any situation with a view to prevent accident or dangerous occurrence during performances of such structural frame and formwork.

14.5. DE-SHORING

a. When shoring is removed, sufficient props shall be left in place of such shoring to prevent any possible hazard; and

b. Deshoring shall be adequately braced and tied together with support to prevent any hazard.

15.0. SAFETY IN CONCRETE WORK

15.1. GENERAL PROVISIONS REGARDING USE OF CONCRETE

a. All construction with the use of concrete or reinforced concrete shall be based on plans including specification of steel and concrete and other material to be used in such construction –

   i. Giving technical details regarding methods for safe placing and handing of such materials and indicating the type, quality and arrangement of each part of a structure of such construction; and

   ii. Explaining the sequence of steps to be taken for completion of such construction;

b. Formwork and shores used for concrete work shall be structurally safe and properly braced or tied together so as to maintain position and shape of formwork or shores;

c. Formwork structure used shall have sufficient catwalks and other secure access for inspection of such structure if such structure is in two or more tiers;

d. No machinery or any object should fall below by using wire nets, screen nets etc.

15.2. PREPARATION AND POURING OF CONCRETE AND ERECTION OF CONCRETE STRUCTURE

a. A building worker handling cement or concrete shall –

   i) Wear close-fitting clothing, gloves, helmet or hardhat, safety goggles, proper footwear and respirator or mask to protect himself from danger in such handling;

   ii) Keep as much of his body covered as is required to protect himself from danger in such handling;

   iii) Take all necessary precautions to keep cement and concrete away from his skin in such handling;

b. Lime pits shall be fenced or enclosed and filled and emptied by such devices, which do not require workers to go into the pit;

c. Moving parts of the elevators, hoists screens bunkers, chutes, grouting equipment used for concrete work and of other equipment used for storing, transport and other handling ingredients of concrete shall be securely fenced to avoid contact of building workers with such moving parts;

d. Screw conveyors used for cement, lime and other dusty materials shall be completely enclosed.

15.3. BUCKETS

a. Concrete buckets used with cranes or aerial cableways shall be free from projections from which accumulations of concrete could fall;

b. Movements of concrete buckets shall be governed by signals necessary to avoid any danger by such movements.

15.4. PIPES AND PUMPS

a. A scaffolding carrying a pipe for pumped concrete shall be strong enough to support such pipe at a time when such pipe is filled with concrete or water or any other liquid and carry the combined load of the all the building workers who may be on such scaffold at such time, safely;

b. Every pipe for carrying pumped concrete shall be –

   i) Securely anchored at its end point and at each curve on it;

   ii) Provided near the top of such pipe with an air release valve;

   iii) Securely attached to a pump nozzle by a bolted collar or other adequate means;

c. The operation of concrete pumps shall be governed by standard signals;

d. Building workers employed around a concrete pump shall wear safety goggles;

15.5. MIXING AND POURING OF CONCRETE

a. The concrete mixture shall not contain any material, which may unduly affect the setting of such concrete, weaken such concrete or corrode steel used with such concrete;

b. When dry ingredients of concrete are being mixed in confined spaces such as silos –

   i) The dust shall be exhausted at the time of such mixing and

   ii) In case the dust the dust cannot be exhausted, as specified, the workers shall wear respirators at the time of such mixing;

c. When concrete is being tipped from buckets, building workers shall be kept out of the range of any kickbacks of such buckets;

d. Loads shall not be dumped or placed on settling concrete.

15.6. CONCRETE PANELS AND SLABS

a. All parts of a concrete panel or concrete slab shall be hoisted uniformly;

b. Concrete panels shall be adequately braced in their final positions and such bracings shall remain in such positions until such panels are adequately supported by other parts of the construction for which such panels are used;

c. Temporary bracings of concreter panels shall be securely fastened to prevent any part of such panels from falling when such panels are being moved.

15.7. STRESSED AND TENSIONED ELEMENTS

a. Building workers shall not stand directly over jacking equipment while stressing of concrete girders and beams is being done;

b. A pre – stressed concrete unit shall not bee handled except at points on such unit and by the devices specified for such work by the manufacture of such devices;

c. During transport, pre-stressed concrete girders or concrete beams shall be kept upright by bracing or other effective means;

d. Anchor fittings for pre-tensioned strands of pre-stressed concrete girders of concert beams are kept in a safe condition in accordance with the instruction of manufacturer of such anchor fittings;

e. Building workers shall not stand behind jacks or in line with tensioning elements and jacking equipment during tensioning operations of pre-stressed concrete girders of concrete beams;

f. Building workers do not cut wires of pre – stressed concrete girders or concrete beams under tension before such concrete used of such girder or beams is sufficiently hardened.

15.8. VIBRATORS

a. A building worker, who is in good physical condition, shall operate vibrators used in concreting work;

b. All practical measures shall be taken to reduce the amount of vibration transmitted to the operators working in concreting work and

c. When electric vibrators are used in concreting work

   i) Such vibrators shall be earthed;

   ii) The leads of such vibrators shall be heavily insulated; and

   iii) The current shall be switched off when such vibrators are not in use.

15.9. INSPECTION AND SUPERVISION

a. A person responsible for a concreting work shall supervise the erection of the formwork, shores, braces and other supports used for such concreting work, make a through inspection of every formwork to ensure that such formwork is safe, regularly inspect the formwork, shores, braces, reshores and other supports during the placing of concrete, keep all records of inspections referred to above at the workplace relating to such inspection and produce them for inspection upon the demand.

b. Any unsafe condition, which is discovered during the inspections, shall be remedied immediately.

15.10. BEAMS, FLOORS AND ROOFS

a. Horizontal and diagonal bracings shall be provided in both longitudinal and transverse direction as may be necessary to provide structural stability to formwork used in concreting work and shores used in such concreting work shall be properly seated on top and bottom and secured in their places;

b. Where shores used in concreting work rest upon the ground, base plates shall be provided for keeping such shores firm and in level;

c. Where the floor to ceiling height of a concreting work exceeds 9 m or where the formwork deck used in such concreting work is supported by shores constructed in two or more tiers, or where the dead, live and impact loads on the formwork used in such concreting work exceed 700 kilogram per m^2, the structure of such formwork shall be designed by a professional engineer in the relevant field and the specifications and drawings of such formwork kept at such construction site and produced on demand.

d. Where a professional engineer designs the structure of the formwork used in concreting work, such engineer shall be responsible for the supervision of construction and the stability of such structure.

15.11. STRIPPING

a. Stripping of formwork used in concreting work shall not commence until the concrete on such formwork is fully set, examined and certified to this effect by the responsible person and record of such examination and certification is maintained;

b. Stripped forms in concreting work shall be removed or stock piled promptly after stripping from all areas in which building workers are required to work or pass;

c. Protruding nail, wire ties and other formwork accessories not required for subsequent concreting work shall be pulled, cut or otherwise made safe.

15.12. RE-SHORING

a. Re-shoring used in concreting work shall be provided to a slab or beam for its safe support after its stripping or where such slab or beam is subjected to superimposed loads due to construction above such slab or beam;

b. The provisions applicable to shoring in a concreting work shall also be applicable to reshoring in such work or pass.

16.0. SAFETY IN CONSTRUCTION, REPAIR & MAINTENANCE OF STEEP ROOFS

16.1.WORK ON STEEP ROOFS:

All practicable measures shall be provided to protect the building workers against sliding when carrying outwork on steep roofs.

16.2. CONSTRUCTION AND INSTALLATION OF ROOFING BRACKETS

a. Roofing brackets shall be constructed to fit the pitch of steep roof and such brackets shall be used to provide level working platform;

b. Roofing bracket shall be secured in its place by nailing pointed metal projections attached to the underside of such bracket and securely driven into a steep roof on which it is used or secured by a rope passed over the ridgepole and tie of such roof.

16.3. CRAWLING BOARDS

a. All crawling boards used for work on steep roofs shall be of adequate strength, made of sound material and of the type approved for the purpose of their use;

b. Crawling boards shall be kept in good repairs and inspected by a responsible person before being taken into use;

c. Crawling boards shall be secured to a steep roof on which it is used by ridge hooks or other effective means;

d. A firmly fastened lifeline of adequate strength shall bee strung beside each crawling board throughout its length while using such crawling boards.

17.0. SAFETY IN CATCHES PLATFORMS, HOARDINGS & CHUTES

17.1. CATCH PLATFORM

a. Catch platform shall not be used for storage of material or as a working platform;

b. Catch platform shall at least be of 2 m wide and inclined so that the position of outer edge of such platform is 1500 mm higher than the inner edge;

c. The open end of catch platform shall be properly fenced to the height not less than 1 m.

17.2. HOARDINGS:

Hoardings shall be constructed when the Registering Authority / Assistant Labour Commissioner considers it necessary for protection of building workers and directs such employer to construct such hoardings.

17.3. CHUTES, ITS CONSTRUCTION AND USE

a. Wooden or metal chutes which are at an angle of more than 45^0 to the horizontal and used for the removal of materials shall be closed on all sides except at their openings used for receiving or discharging of materials or articles;

b. All openings of chutes except their top openings shall be closed when not in use;

c. Every chute –

i. Shall be constructed of sound material, adequate strength and suitable for the purpose it is intended for use;

ii. Exceeding 12 m in height shall be constructed in accordance with the design and drawings of professional engineer for such;

iii. A suitable warning notice shall be displayed at conspicuous locations, written in Hindi and in a local language, at the discharge end of every chute;

iv. Shall be cleared when debris has accumulated to a height, which can pose danger to building worker, but such clearance shall be done in no case less frequently than once a day.

18.0. SAFETY IN WORK ON OR ADJACENT TO WATER

18.1. TRANSPORT OF WORKERS BY WATER

a. When any building worker has to proceed to or from any workplace by water for purposes of carrying on a building or other construction work, proper measures shall be taken to provide for his safe transportation and vessels used for such purpose shall be in charge of a responsible person, properly equipped for safe navigation and maintained in good condition;

b. Maximum number of persons which can be safely carried in a vessel shall be marked plainly and conspicuously on such vessel and such number shall not be exceeded during use of such vessel for carrying persons;

c. Adequate protecting shall be provided to the building workers in such vessel from inclement weather;

d. Such vessel shall be manned by adequate and experienced crew;

e. In case the bulwarks of such vessel are lower than 60 cm from the level of the deck of such vessel, the open edge of such bulwarks shall be fitted with suitable fencing to a height of at least 1 m above such deck and the post and stanchions and similar parts used in such fencing shall not be spaced more than 2 m;

f. The number of life buoys on deck of such vessel shall at least be equal to the number of crew members of such vessel and shall not be less than two;

g. All life buoys on deck of such vessel shall be kept in good state of maintenance and so placed that if such vessel sinks then they will remain afloat and one of such buoys shall be within the immediate reach of the Steersman of such vessel and another is situated after part of such vessel; and

h. The position of the steersman of the vessel shall be such that he has a reasonably free view of all sides.

18.2. PREVENTION FROM DROWNING

a. Where, on or adjacent to the workplace of any contraction site, there is water into which a building worker employed for work on such site, in the course of his employment, may fall and has the risk of drowning, suitable rescue equipment shall be provided and kept in an efficient state of ready use and measures shall be taken to arrange for the prompt rescue of such building worker from the danger of drowning and where there is a special risk of such fall from the edge of adjacent land or from a structure adjacent to or above the water, or from floating stage on such water, secure fencing shall be provided near the edge of such land, structure or floating stage, as the case may be, to prevent such fall, and such fencing may be removed or allowed to remain unerected for the time and to the extent necessary for the access of building workers to such work or the movement of material for such work;

b. For handling rescue equipment, at least two persons knowing diving should be available at such sites.

19.0 SAFETY IN COFFERDAMS & CAISSONS

19.1 EVERY COFFERDAM AND CAISSON SHALL BE

19.1.1 Of good construction, sound material and of adequate strength, provided with adequate means for workers to reach safely at the top of such cofferdam or caisson in the event of an in rush of water and safe means of access to every place where workers shall be employed;

19.1.2 Work relating to construction, positioning, modification, dismantling of cofferdams or caissons shall be carried out under the supervision of a responsible person and inspected by the responsible person at the specified intervals;

19.1.3 A worker shall be allowed to work in a cofferdam or caisson after such cofferdam or caisson has been inspected and found safe by responsible person within such preceding period as approved and a record of such inspection maintained.

19.2 WORK IN COMPRESSED AIR IN A COFFERDAM OR CAISSON SHALL BE

19.2.1 Carried out in accordance with the procedure laid down;

19.2.2 Carried out by such building workers who have completed eighteen years of age and are medically examined and found fit for the work;

19.2.3 Carried out under the supervision of a responsible person;

19.2.4 If the work in cofferdam or caisson is carried out in shifts, a record of the time spent by each worker in each such shift for carrying out the wok shall be maintained in a register with particulars or time taken for the compression of such building worker, if any;

19.2.5 At every work site or project in a cofferdam or caisson, where workers are employed to work in compressed air environment, a construction medical officer assisted by a nurse or trained first-aid attendant, shall be available at all times and there shall be one standby reserve compressor to meet the emergency.

19.3 **PRESSURE PLANT AND EQUIPMENT**

19.3.1 Pressure plant and equipment for which it is used shall be –

19.3.2 Properly maintained in good repairs and working condition and fitted with a suitable safety valve or other effective device to provide maximum safe discharge pressure from being exceeded at any time; a suitable pressure gauge with a dial range not less than 1.5 time and not exceeding twice the maximum working pressure, easily visible and designed to show at all times, the internal pressure in kilogram per square centimeter and marked with the maximum safe working pressure, a suitable stop valve or valves by which the pressure plant or the system of the pressure plant may be isolated from the source supply of pressure or otherwise;

19.3.3 Every pressure plant or equipment shall be thoroughly examined by the competent person, externally, once in every period of six months; internally, once in every period of twelve months; and by hydraulic test, once in a period of four years.

20. SAFETY IN DEMOLITION WORK

20.1PREPARATION

20.1.1 All glass or similar material or article in exterior openings shall be removed before commencing any demolition work and all water, steam, electric, gas and other similar supply lines put off and suitably capped and the concerned department of the appropriate authority informed and permission obtained wherever required before commencing;

20.1.2 Wherever it is necessary to maintain water, gas or electric line or power during such demolition, such line shall be so located or protected with substantial coverings so as to protect it from damage and to afford safety to the building workers and the general public.

20.2 PROTECTION OF ADJACENT STRUCTURES

20.2.1 Examination of walls etc. of adjacent structures –

i) During demolition process, the contractor shall examine the walls of all structures adjacent to the structure to be demolished to determine the thickness, method of support to such adjacent structures and;

ii) In case, such employer has reason to believe that any of such adjacent structure is unsafe or may become unsafe during such demolition process, he shall not perform demolition activity unless stability to such unsafe adjacent structu4e from collapsing has been taken. All roads and open spaces adjacent to the site of demolition work shall be closed or suitably protected by bracketing.

20.3 DEMOLITION OF WALLS, PARTITIONS, ETC.

20.3.1 Any demolition of walls or partitions shall be proceeded in a systematic manner as per the standard safe operating practices approved and all work above each tier of any floor beams shall be completed before the safety of the supports of such beam is impaired;

20.3.2 Masonry shall be neither loosened nor permitted to fall in such masses or volume or weight as to endanger the structural stability of any floor or structural supports;

20.3.3 No wall chimney or other structure or part of a structure shall be left unguarded in such a condition that it may fall, collapse or weaken due to wind pressure or vibration;

20.3.4 In the case of demolition of exterior walls by hand, safe footing shall be provided for the workers employed in, such walls or partitions, which are to be demolished by hand shall be not left standing more than one storey high above the uppermost floor on which persons are working.

20.4 **METHOD OF OPERATION:** The contractor shall ensure that debris, bricks and other materials or articles are removed by means of chutes, buckets or hoists and through openings in the floors.

20.5 **ACCESS TO FLOOR**

20.5.1 Safe access to and egress from every building shall be provided at all times in the course of demolition by means of entrances hallways, stairways or ladder runs which shall be so protected as to safeguard the workers using such means from falling material or articles;

20.5.2 Demolition of structural steel etc. shall be demolished column by column and tier by tier and every structural member, which is being demolished, shall not be under any stress, and such structural member shall be suitably lashed to prevent it from any uncontrolled swinging, dropping or falling or falling;

20.5.3 Large structural members shall not be thrown or dropped from the building, but carefully lowered by adopting suitable safe method;

20.5.4 Where a lifting appliance like a derrick is used for demolition, the floor on which such lifting appliance rests shall be completely planked over or supported and such floor shall be of adequate strength to sustain bearing load for such lifting appliance and its operation.

20.6 STORAGE OF MATERIAL OR ARTICLE

20.6.1 No materials or articles shall be not stored or kept on platform, floor or stairways of a building being demolished, provided that this clause shall not apply to the floor of a building when such floor is of such strength as to support safely the load to be superimposed by storing such material or articles;

20.6.2 No access to any stairway or passageway shall be affected or blocked by storing any material or article;

20.6.3 Suitable barricades shall be provided so as to prevent materials or articles from sliding or rebounding into any space used by the workers.

20.7 **FLOOR OPENINGS:**

Every opening used for the removal of debris from every floor which is not closed to access, except the top or working floor, shall be provided with an enclosure from such floor to its ceiling, or such opening is so barricaded that no building worker shall access to within a horizontal distance of 6.0 m from such opening through which debris is being dropped.

20.8 **INSPECTION:**

A person responsible for demolition work shall make continuous inspections during demolition process so as to detect any hazard resulting from weakened or deteriorated floors or walls or loosened materials or articles, and that no building worker shall be permitted to work where such hazard exist unless remedial measured like shoring or bracing shall be taken to prevent such hazards.

20.9 **WARNING SIGNS, BARRICADES, ETC.**

20.9.1 Barricades and warning sign shall be erected along every side throughout the length and breadth of a building or other construction work to be demolished to prevent unauthorized persons from entering into the during demolition operations;

20.9.2 During the demolition of an exterior masonry wall or a roof from a point more than 12 m above the adjoining ground level of such wall or roof, if persons below such wall or roof are exposed to falling objects, suitable and safe catch platform shall be provided and maintained at a level not more than 6 m below the working level except where an exterior built-up scaffold is provided for safe and adequate protection of such persons;

20.9.3 Suitable and standard warning signs shall be displayed or erected at conspicuous places or position at the workplace;

20.10 **MECHANICAL METHOD OF DEMOLITION**

20.10.1 The following requirements shall be fulfilled in case the mechanical method of demolition like use of swinging weight, clamshell bucket, power shovel, bulldozer or other similar mechanical methods are used for the purpose of demolition namely –

i) The building or structure or structure or remaining portion thereof shall be not more than 12 m in height;

ii) Where a swinging weight is used for demolition, a zone of such demolition having a radius of at least 1.5 times the height of the structure of portion thereof being demolished shall be maintained around the points of impact of such swinging weight;

iii) Where a clamshell bucket is being used for demolition, a zone of demolition shall be maintained within eight metres of the liner of travel of such bucket;

iv) Where other mechanical methods are being used to affect total or partial collapse of a building or other construction work, there shall be maintained, in the area into which the affected portion of such building or other construction work may fall, a zone of demolition at least 1.5 times the height of such affected portion thereof; and

v) No person other than building workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition, which shall be provided with substantial barricades.

21. FIRE EXTINGUISHERS & OTHER APPLIANCES OF FIRE FIGHTING

21.1 FIRE EXTINGUISHERS & OTHER MEANS OF PREVENTION AND PROTECTION

21.1.1 Every contractor shall have a fire protection and prevention plan developed and implemented keeping in view the following:

i) The specific work practices requiring fire control measures;

ii) Response measures to be taken in case of fire;

iii) Equipment required;

iv) Personnel requirements and responsibilities;

v) Schedules of daily and weekly inspection;

vi) Open flames and fires are prohibited in all underground construction;

vii) Readily visible signs to be posted in the fire prone/inflammable/explosive areas prohibiting smoking use of open flames and other hot work.

viii) A system of Permit-to-Work.

27.1.2 For the protection of the workers from the outbreak of fire, the contractor shall Provide, maintain and regularly inspect the Fire extinguishing equipment, which shall be sufficiently provided to extinguish any probable fire;

Suitability of portable fire extinguishers			
Class of fire	Type of extinguisher		
	Water	DCP	CO_2
A	Yes	Yes	Yes
B	No	Yes	Yes
C	No	Yes	Yes
D	No	Yes	Yes
Electrical	No	Yes	Yes

27.1.3 Ensure availability of an adequate supply of water at ample pressure;

27.1.4 Make available

i. Adequate number of trained persons required to operate the fire extinguishing equipment;

ii. Properly maintain Fire extinguishing equipment and inspect them at regular intervals of not less than once in a year by the responsible person and a record of such inspections maintained;

27.1.5 Portable fire extinguishers provided in the operator's cabin of earthmoving machinery, material handling systems, construction equipment etc. shall be regularly inspected, maintained and replenished/refilled;

27.1.6 The operators and the helpers of such equipment shall be trained in the methods operating the equipment and fighting the fire effectively;

27.1.7 All combustion engine power equipment shall be so located that the exhausts are well away from combustible material;

27.1.8 No smoking shall be allowed at or in the vicinity of operations, which constitute fire hazards and shall be conspicuously posted with No smoking or open flame **signs;**

27.1.9 In the flammable environment as described in IS: 9570, the electrical fittings and equipment shall be of flame proof type conforming to IS: 2206 & IS; 2148;

27.1.10 Arrangements shall be made to contain sparks generated during welding, cutting or other operations and spark shall not be allowed to fall down on combustible material kept below; All means of exit shall be kept free of obstruction at all times;

27.1.11 Appropriate type of fire extinguishers according to IS: 5698 shall be kept in fully charged condition at the places which have potential risk of fire;

27.1.12 The contractor shall educate his or his sub-contractors' men working in the vicinity of fire risk, on how to operate these equipment and know in particular circumstances which type of extinguishers is to be used;

27.1.13 The contractor shall take full responsibility for the upkeep and replenishment/refilling of the fixed and portable fire extinguishers.

APPENDIX

Annexure I

IMPORTANT INDIAN STANDARDS RELATED TO SAFETY

Personal Protection

IS: 1179-1967 Equipment for eye and face protection during welding
IS: 4770-1991 Rubber gloves for electrical purposes
IS: 8519-1977 Guide for selection of industrial safety equipment for body protection
IS: 8520-1977 Guide for selection of industrial safety equipment for eye, face & ear protection
IS: 8807-1978 Guide for selection of safety equipment for protection of arms and hands
IS: 1224-1985 Safety shoes
IS: 2925-1984 Safety helmets
IS: 8940-1978 Code of practice for maintenance and care of industrial safety equipment eye and face protection
IS: 8990-1978 Code of practice for maintenance and care of industrial safety clothing
IS: 10667-1983 Guide for selection of industrial safety for protection of foot and leg
IS: 816-1969 Code of practice for safety and health requirements in electric and gas welding and cutting operations
IS: 818-1968 Code of practice for safety and health requirements in electric and gas welding and cutting operations
IS: 7194-1994 Assessment of noise exposure during work for hearing conservation purposes

Civil Engineering Construction

IS: 2750- 1967(Part II) Steel scaffolds
IS: 875-1987 Structural safety of building: loading standards
IS: 4014-1967 Code of practice for steel tubular scaffolding
IS: 3696 Safety code of scaffolds and ladders
IS: 4138-1977 Safety code for working in compressed air
IS: 4912-1978 Safety requirements for floor and wall openings, railings and toe boards
IS: 7293-1974 Safety code for working with construction machinery
IS: 9944-1992 Recommendations on safe working load for natural and man-made rope slings
BS: 1129 Portable timber ladders, steps, Trestles & lightweight staging
BS: 1139 Metal scaffolds
BS: 5973 Code of practice for access & working scaffolds
BS: 5974 Code of practice for temporary installed scaffolds and access equipment
BS: 5975 Code of practice for falsework

Fire Protection

IS: 2190-1992 Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers
IS: 5896 Code of practice for selection, operation and maintenance of fire-fighting appliances

IS: 8433-1984 Code of practice for dissolved acetylene cylinders

Electrical

IS: 3043-1987 Code of practice for earthing
IS: 5424-1969 Rubber mats for electrical purposes
IS: 3646 (Part II) Artificial lightings
IS: 2148 & IS: 2206 Flame proof electrical fittings

Machinery

IS: 1860-1980 Code of practice for installation, operation and maintenance of electric passenger and goods lifts
IS: 1991-1987 Safety requirements for the use, care and protection of abrasive grinding wheels
IS: 5903-1970 Safety devices for gas cylinders
IS: 8216-1976 Guide for inspection of lift wire ropes
IS: 8964-978 Recommendations for safety conditions for woodworking machines
IS: 9474-1980 Principles of mechanical guarding of machinery
IS: 11461-1985 Code of practice for compressors safety
IS: 13367-1992 Code of practice for safe use of cranes

Annexure - II

BASIC STRUCTURE OF SAFETY PLAN

01- Safety Policy
02- When was the Safety Policy last reviewed
03- Details of implementation procedure / methods to implement Safety Policy / Safety Rules
04- Qualification & Experience of Safety Officers
05- Review of Accidents analysis - Methods to ensure safety & health and steps identified for prevention of accidents
06- Unit/site Executive responsible for ensuring safety at various levels in the workplace
07- List of Employees trained in safety at the commencement of execution of the job; details of training – its module and contents
08- Safety Training Targets, Schedules, Methods to be adopted for providing safety training to all employees
09- Details of checklists for different jobs/ work & responsible persons to ensure Compliance
10- Regular Safety Inspection Methods and Periodicity and the list of members authorized
11- Risk Assessment, Safety Audit by professional agencies, their Periodicity
12- Implementation of recommendations of Audit / Inspections. - Procedures for implementation & follow-up
13- Provision for treatment of Injured persons at work site
14- Review of overall safety by top Management and Periodicity
15- System for implementation of statutory provisions.
16- Issue of PPE to employees, Periodicity / stock on hand, etc.

Signature

Head of Organization

With Date & Stamp

Annexure - III

CONFINED SPACE WORK PERMIT

Date of Work :	Initiator:	Permit No.:	
Description of work :			
Name of person supervising:		Dept./Function:	
Names of workmen involved in the job :			
1		2	
3		4	
Exact Location of Work:			
JSA Referance No.			
Job Instruction & Confirmation Sheet Ref. No			
Valid From : Time …….. Date: …….. To Time: …….. Date: ……..			
Other relevant information (if any)			
Initiated by Engineer / Supervisor of Agency		Checked by Agency Safety Representative	
Name		Name	
Signature		Signature	
Date		Date	

Check list for Authorization of Work Permit		
Minimum and Mandatory Precautions		Y/ N / NA
1	Permit form filled in completely?	
2	Have wind, atmospheric, and work area conditions (e.g. cold, hot, snow, poor lighting & Ventilation etc.) been considered throughout the job so that work can be done safely?	
3	All necessary Personnel Protective Equipment like Breathing Set, Waist Rope, Light Mounted Helmet etc. is put on by all the workmen?	
4	A lifeline, a rope tied on the safety belt of the person entering the confined space is provided?	
5	All practicable measures are taken to ensure that the atmosphere inside is not deficient in oxygen and does not contain flammable vapors and no hazardous gases like H2S. (Open at least 2 manholes & keep for 2 hours)?	
6	One fully trained person is stationed at ground level/outside to assist the inside workers and emergency contact No's available?	
7	All the workers trained for emergency?	

8	Safe means of access and egress provided?	
9	Is the suitable fire extinguisher available at work location?	
10	Are they Using only 24V lamps & working tools inside the confined space?	

Following additional precautions need to be taken before the start of the work		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

HOT WORK PERMIT

Date of Work :	Initiator:	Permit No.:	
Description of work :			
Name of person supervising:		Dept./Function:	
Names of workmen involved in the job :			
1		2	
3		4	
Exact Location of Work:			
JSA Referance No.			
Job Instruction & Confirmation Sheet Ref. No			
Valid From : Time …… Date: …… To Time: …… Date: ……			
Other relevant information (if any)			
Initiated by Engineer / Supervisor of Agency		Checked by Agency Safety Representative	
Name		Name	
Signature		Signature	
Date		Date	
Exact location of work			
Relevant information			
Check list for Authorization of Work Permit			

Minimum and Mandatory Precautions		Y/ N / NA
1	Permit form filled in completely?	
2	Form filled in correctly and in full.	
3	Has the work area been inspected for any abnormalities - specify on wind, atmosphere, surroundings, etc.	
4	Are the necessary PPE provided and do the workmen know their use?	
5	Is the fitter, experienced and knowledgeable enough to carry out the job?	
6	Area has to be cleared of any flammables and combustible material.	
7	Electrical equipment to be protected and grounded.	
8	Are fire-fighting equipment - extinguishers, water, sand buckets etc, located nearby for ready in case of any mishap?	
9	Gas cylinders in upright state/ trolleys/ flash-back arrestors/ hose condition/ NRVs, etc.	
10	Is the area easily accessible?	

Additional precautions to be taken:		
This permit is valid only for one week. A fresh hot work permit has to be taken for continued works for the next week.		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

PERMIT FOR LIFTING OF MATERIAL

Date of Work :	**Initiator:**	**Permit No.:**
Description of work:		
Name of person supervising:	**Dept./Function:**	
Names of workmen involved in the job :		
Exact Location of Work:		
JSA Reference No.		
Job Instruction & Confirmation Sheet Ref. No		
Valid From : Time …….. Date: …….. To Time: …….. Date: ……..		
Other relevant information: (If any)		

Initiated by Engineer / Supervisor of agency		**Checked by Agency Safety Representative**	
Name		Name	
Signature		Signature	
Date		Date	

Check list for Authorization of Work Permit

1	Details of type of crane(s) to be used?
2	Name of Lift Co-ordinator, Rigger/Crane Operator?
3	Adequate and suitable lifting gears available and in good condition
4	Have soil, wind, atmospheric, and work area conditions (e.g. cold, hot , snow, poor lighting & Ventilation etc.) been considered throughout the job so that work can be done safely?
5	Lifting Equipments, Lifting gears and Slings are tested and certified?
6	Are all operators trained, competent and healthy (Having Licenses / Experience Certificate)?
7	Are all the examinations and tests carried out on the equipment (Crane) and certified by competent persons?
8	Is the safe working load (SWL) marked on all lifting tools & tackles?
9	Lifting area cordoned off?
10	Tag lines provided to control the swing of load?
11	Load tied properly and secured against toppling and falling?
12	Signalman/Rigger is provided and competent?
13	Proper communication available between operator and rigger?
14	Is the vehicle for transportation adequate for the load?

Following additional precautions need to be taken before the start of the work:			
Permit Issue b By:			
Approved by Principal agency work incharge		**Endorsed by main agency HSE Dept**	
Name		Name	
Signature		Signature	
Date		Date	
Permit Close Out by: Name & Signature (Main agency)			
Date :		**Time :**	
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.			

WORKING AT HEIGHT PERMIT

Date of Work :	Initiator:	Permit No.:	
Description of work :			
Name of person supervising:		Dept./Function:	
Names of workmen involved in the job :			
1		2	
3		4	
Exact Location of Work:			
JSA Referance No.			
Job Instruction & Confirmation Sheet Ref. No			
Valid From : Time …….. Date: …….. To Time: …….. Date: ……..			
Other relevant information			
Initiated by Engineer / Supervisor		Checked by Agency Safety Representative	
Name		Name	
Signature		Signature	
Date		Date	

Check list for Authorization of Work Permit		
Minimum and Mandatory Precautions		Y/ N / NA
1	Permit form filled in completely?	
2	Work area below is temporarily cordoned/barricaded	
3	The scaffold erected has pipes and clamps in good condition.	
4	Diagonal / lateral bracings pipes are provided to ensure stability	
5	Access ladder is provided to reach the work location	
6	Planks / sheet used in temporary platform are in good condition	
7	Planks / sheets are tied properly using binding wire	
8	Temporary platform is having temporary side railing	
9	Workers are wearing Helmet, Shoes & Safety belt in good condition.	
10	For Anchoring of safety belt at height rigid support / life rope line is provided	
11	Experienced workers are engaged for work	
12	Portable elect equip/fibre body checked for its healthiness including earthing	
13	The sling / pulley blocks / ropes are tested for fitness	

14	Workers are briefed on Safety Precautions to be taken	
	Power hand tools used at eight are connected through 30mA ELCB.	

Following additional precautions need to be taken before the start of the work		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

Annexure - IV

DEFINITIONS

1. **Building or other construction work:** means the construction, alteration, repairs, maintenance or demolition, of or, in relation to, buildings, streets, roads, railways, tramways, airfields, generation, transmission and distribution of power, water works, oil and gas installations, electric lines, tunnels, bridges, viaducts, pipelines, towers, cooling towers and such other work as may be specified.

2. **Building worker:** means a person who is employed by a contractor to do any skilled, semi-skilled or manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment be expressed or implied, in connection with any building or other construction work;

3. **Establishment:** means an establishment who or which employs building workers in any building or other construction work, and includes an establishment belonging to a contractor;

4. **Contractor:** means a person who undertakes to produce a given result for any establishment, other than a mere supply of goods or articles of manufacture by the employment of building workers or who supplies building workers for any work of the establishment, and includes a sub-contractor or any other agency engaged on his behalf;

5. **Employer:** in relation to an establishment, means the owner thereof that is the contractor himself.

6. **Competent Person:** means a person so approved by the Central Government who belongs to a testing establishment in India possessing adequate qualification, experience and skill for the purpose of testing, examination or annealing and certification of lifting appliances, lifting gears, wire ropes or pressure plant or equipment;

7. **Responsible Person:** means a person appointed by the employer to be responsible for the performance of specific duty or duties and who has sufficient knowledge and experience and the requisite authority for the proper performance of such duties;

8. **Danger:** means danger of accident or of injury or danger to health;

9. **Hazard:** means danger or potential danger;

10. **Hazardous substance:** means any substance, which due to its explosiveness, inflammability, radioactivity, toxic or corrosive properties and similar hazardous characteristics may Cause injury; or Affect adversely the human system; or Cause loss of life or damage to property or environment;

11. **Hazardous Process:** comprises roof work, steel erection, and work under and over water, demolition and work in confined space;

12. **National Standard:** means standards as approved by the Bureau of Indian Standards (BIS) and in the absence of such standards, the standards approved by the Central Government for a specific purpose;

13. **Lifting Appliance:** means a crane, hoist, derrick, winch, jack, pulley block or other equipment used for lifting materials, objects or building workers;

14. **Lifting gear:** means ropes, chains, hooks, slings and other accessories of a lifting appliance;

15. **Safe Operating Practice:** Means the practice followed in building and construction activities for the safety of workers and for safe operation of machinery and equipment used in such activities. Such practices shall conform to all or any of the following:

    Relevant Standards approved by BIS;

    National Building Codes;

    Manufacturer's instruction on safe use of equipment and machinery;

    Code of practice on safety in construction industry published by International Labour Organization .

16. **Safe working load**: in relation to an article of lifting gear or lifting appliance, means the load which is the maximum load that may be imposed on such article or appliance with safety in the normal conditions as assessed and certified by a competent person;

17. **Workplace**: means all places where building workers are required to be present or to go for work and which are under the control of an employer;

18. **Personal Protective Equipment (PPE):** are the protective devices made available for individual or collective use of the workers likely to be affected by the hazards of the workplace or process;

19. **Construction & Erection Manual (E&C) Rules**: all references to E&C Manual shall mean the Construction & Erection Rules that are detailed hereunder;

20. **Engineer in-charge**: All references to the Engineer in-charge shall mean the person in-charge of a building and construction of the NTPC.

21. **Interpretation of words not defined: words and expressions not defined or used in this Manual shall have the same meaning as generally assigned in common engineering practices**

NTPC COLOR AND CODING SCHEME

(QS-01-DIV-W-4)

FOR

EQUIPMENT AND PIPING

1. 0 PURPOSE

The purpose of this work instruction is to provide the uniform colour and coding scheme for the painting of the equipment and piping installed in our power plant by various vendors. This will help enhance the aesthetic ambience of an otherwise industrial environment. At the same time, for identification purpose, colour code/tags have been enumerated for labeling of articles; equipment, pipes, structures etc.

2. 0 SCOPE

2.1. **The Colour and Coding Scheme** covers applications of Ground Colour and Colour Tags/ Bands on power plant equipment, piping & ducting as final coat over and above the protective coatings for the purpose of identification.

2.1. **The Surface Preparation** process and sequence of painting, Statutory requirements and other public Safety Regulations is beyond the scope of this standard.

3. 0 DEFINITIONS AND ABBREVIATIONS

3.1. HOD – Head of the Department

3.2. MR – Management Representative

3.3. IS – Indian Standard

4. 0 DESCRIPTION

4.1 ISO 9001 –2000, Clause 7.5.3

4.2 Quality Manual Section 7.5.3

4.3 QS-01-DIV-W-01. Guideline for drafting procedure / work instruction / guidelines.

5.0 PROCEDURE

5.1 **Colour Scheme for Equipment**

Major Equipment in a Building or elsewhere shall be finished with main shade of a colour scheme, while the minor equipment, pipes, etc. shall be finished with secondary shade, as enumerated in accompanying annexures.

5.2 **Colour Scheme for Pipelines**

The Ground Colour shall be as per the over all Colour Scheme. Generally it shall follow the secondary shade of Colour Scheme.

5.3 **Identification**

In the case of pipelines, IS: 9404 – 1979 "Colour code for identification of pipelines used in Thermal Power Plants" is followed for LABELLING or TAGGING so that Identification of numerous pipelines in a Thermal Power Plant can be done by adopting a system of colour coding consisting of a Colour Band Tag with distinct legend for each system. Direction of flow with an arrow shall be marked near valves junction fittings etc. To indicate flow & return flow pipes, words F&R will be written in the legend respectively.

5.4 **Colour Band**

Colour band is superimposed on the ground colour Fig 2A & 2B Appendix C to distinguish one kind or condition of the fluid it carries: for example, condensate from boiler feed, clarified water from drinking water etc.

5.5 **Application**

5.5.1 Ground colour may be applied in one of the following ways :-

a. The ground colours shall be applied throughout the entire length of pipe line :-

b. The Colour Code Band/ Tag as an identification mark shall be applied as follows:

i) At Start and finish of the pipes.

ii) At Inlet and at outlet of valves.

iii) Near junction and fittings.

iv) Before & after Walls and floors where pipe is crossing them.

v) It shall also be applied at intermediate points. But in no case, the distance between two consecutive colour bands shall exceed 5 meters.

c. Colour bands shall have a minimum width of 75 mm. Where hazardous materials are carried in the pipes the colour bands shall be slant as shown in Fig.-3.

d. The recommended colour bands for the pipe lines with their ISC/RAL nos. are given in Appendix – B.

5.6 Addition Identifications

5.6.1 **Lettering**

a) For identification purpose, Colour Code/Tags have been enumerated for labeling of articles; equipment, pipes, structures.

b) The recommended size of lettering for pipes of different diameters is given below:

Outside Dia of pipe of Covering	Size of Legend
mm	mm
20 to 100	10
100 to 250	40
250 & above	60

The lettering shall be given on a bordered rectangular patch background, which has been designated as Colour Code Tags/ Bands.

5.6.2 **Direction of Flow**

Where it is required to be indicated the direction of flow arrow may be painted near the valves fittings, junctions, walls etc. and at suitable intervals along the pipeline in a manner best suited to local conditions. These shall be black in colour. If a label or badge with a codified indication is attached to the pipe the direction of flow may be indicated by the painted end of the label or badge or a painted arrow.

5.6.3 Visibility of Markings

Consideration should be given to the visibility of the letters from the Working platforms. For example where the pipelines are located above the normal line of vision of the operator, the lettering should be placed below the horizontal line of the pipeline.

6.0 ASSOCIATED DOCUMENTS

- **NIL –**

APPENDIX A

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	MAIN PLANT						
1.	Main Turbine	Blue	5012	White		9010	Legend in black letters
2.	Main generator	Blue	5012	White		9010	Legend in black letters
3.	Condenser	Blue	5012	White		9010	Legend in black letters
4.	Ejectors & Vaccum Pumps	Blue	5012	White		9010	Legend in black letters
5.	Heat exchangers (eg. Deaerator LP & HP heaters, gland steam condenser, lube oil cooler, stators water cooler etc.	Blue	5012	White		9010	Legend in black letters
6.	Flash tanks (HP, LP, etc.)	Blue	5012	White		9010	Legend in black letters
7.	**Pumps**						
	i) Boiler feed pumps	Blue	5012	White		9010	Legend in black

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
							letters
	ii) Condensate extraction pumps	Blue	5012	White		9010	Legend in black letters
	iii) Lube oil	Grey	9002	White		9010	Legend in black letters
8.	Valves, gates, filters	Grey	9002	White		9010	Legend in black letters
9.	**Turbine oil system**						
	i) Main oil tank	Grey	9002	White		9010	Legend in black letters
	ii) Central oil tank	Grey	9002	White		9010	Legend in black letters
	iii) Oil purifier & Polishing filter	Grey	9002	White		9010	Legend in black letters
10.	Boiler steel supporting	Grey	9002	White		9010	Legend in black letters
11.	Boiler coating	Grey	9002	White		9010	Legend in black letters

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
12.	Superheaters (exposed portions if any)	Grey	9002	White		9010	Legend in black letters
13.	Metal structures i) Primary Members ii)Secondary Members	 Blue Grey	 5012 9002				 Columns & Beams Tie/ Bracing's/ Struts etc.
14.	Hand rails	Blue	5012				Wherever required otherwise SS or GI
15.	Pipe supports	Black	9011				
16.	Gratings (non-galvanised)	Black	9011				
17.	Air ducts	Grey	9002	White		9010	Primary, secondary, rear, igniter, scanner air etc. with hot or cold indication to be identified in black letters.
18.	FANS/ PA/ Scanner (booster) air/ igniter air/ Seal air fan	Grey	9002	White		9010	Legend in Black Letters.
19.	Flue gas ducts	Grey	9002	White		9010	Legend in Black Letters.

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
20.	ID fans	Grey	9002	White		9010	Legend in Black Letters.
21.	Coal mills and associated feeders	Grey	9002	White		9010	Legend in Black Letters.
22.	Mill reject system grey green	Grey	9002	White		9010	Legend in Black Letters.
23.	Paddle feeders below track hopper	Golden Yellow	1004	Signal Red	537	3001	For moving parts parts black strips should be superimposed over the base colour.
24.	Travelling Tripper	Golden Yellow	1004	Signal Red	537	3001	For moving parts black strips should be superimposed over the base colour.
25.	Stacker cum	Golden Yellow		Signal Red	537	3001	For moving parts black strips should be superimposed over the base colour.
26.	Belt feeder	Golden		Signal Red	537	3001	For moving parts black strips should

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
		Yellow					be superimposed over the base colour.
27.	Drive frames, take-off units chutes, guards of conveyors	Grey	9002	White		9010	Legend in Black letters
28.	Stringer & stands, mouthpieces, tail end frames head end frames, other supporting structures of various other accessories and other equipments, not covered in this list.	Grey	9002	White		9010	Legend in Black letters
29.	Coal crushers	Grey	9002	White		9010	Legend in black letters
30.	Vibrating feeders	Grey	9002	White		9010	Legend in black letters
31.	a. Dust extraction system piping	Grey	9002	White		9010	Legend in black letters
	b. Ventilation system consisting of GI ducting	Grey	9002	White		9010	Legend in black letters

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	c. Dust suppression system consisting of GI piping	Grey	9002	White		9010	Legend in black letters
32.	Steel gratings and grids over emergency hopper	Black					
33.	Conveyor system – idler frames	Grey	9002				
34.	Structural steel work fabricated at site	Grey	9002				
FUEL OIL HANDLING SYSTEM							
35.	HSD storage tank	Blue	5012	White		9010	Legend HSD to be displayed in Black letters
36.	Furnance oil storage tank	Blue	5012	White		9010	Legend FO to be displayed in Black letters
37.	Pumps, filters and valves	Blue	5012	White		9010	Legend in black letters

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
ASH HANDLING SYSTEM							
38.	Bottom ash hopper	Blue	5012	White		9010	Legend in black letters
39.	Scraper	Blue	5012	White		9010	Legend in black letters
40.	Clinker Grinder	Blue	5012	White		9010	Legend in black letters
41.	Flush mixer	Blue	5012	White		9010	Legend in black letters
RAW WATER INTAKE EQUIPMENTS							
42.	Intake gates						
	- Above water parts	Grey	9002				
	- Sub merged parts	Grey	9002			9010	
	- Rotating Mechanism	Grey	9002				
	- Sub Merged beams	Grey	9002				
	- Travelling	Grey	9002				
INSTRUMENT AND SERVICE / PLANT AIR SYSTEM							
43.	Trash Rack						

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	- Above water stationary parts	Grey	9002	White		9010	Legend in black letters
	- Above/Under water/moving parts	Grey	9002	White		9010	
44.	Metal structures						
	- External	Grey	9002				
	- Internal	Grey	9002				
	DEMINERALIZED WATER SYSTEMS						
45.	Filter beds and Ion Exchange resin beds.	Grey	9002				To be Identified by suitable legends.
46.	Air blowers	Grey	9002	White		9010	Legend in black letters
47.	Carbon dioxide exhausters.	Grey	9002	White		9010	Legend in black letters
	INSTRUMENT AND SERVICE/PLANT AIR SYSTEM						
48.	Compressors with inter and after coolers	Blue	5012	White		9010	Identifying legends to be used.

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
49.	Heater/Drivers	Grey	9002	White		9010	-
50.	Air receivers	Blue	5012	White		9010	Legend in black letters
MISCELLANEOUS EQUIPMENTS							
51.	Cranes	Golden Yellow	1004	White		9010	Tower Cranes & Booms will have alternate sections for Signal Red/White for aviation requirement with diagonally painted sections in black.
	- Mono Rails & chain pulley systems	Golden Yellow	1004				
52.	Hooks	Signal Red	3001				
53.	Tanks	Grey	9002	white			Legend in Black letters
54.	Doors industrial type	Blue	5012				
55.	Solid wastes processing equipment	Grey	9002				
56.	Hydraulic power unit	Golden	1004	Signal Red	537	3001	

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
		Yellow					
57.	Fencing	Black					
58.	Lighting poles	Alumin ium					
59.	Chimney						As per safety regulations Top two bands in Gulf Red & White 3000 mm each.
	ELECTRICAL COMPONENTS						
60.	**MAIN GENERATOR**						
	- Lub oil system - Seal Oil System	Grey	9002	White		9010	Legend in Black Letters
	- Hydrogen system - Stator Water Sys.	Grey	9002	White		9010	Legend in Black Letters
61.	**DIESEL GENERATOR SET**						
	- Diesel Engine	Grey	9002	White		9010	

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	- Generator	Grey	9002	White		9010	
62.	**L.T. TRANSFORMERS**						
	- Indoor	Blue	5012				Legend in Black Letters
	- Outdoor	Blue	5012				Legend in Black Letters
63.	33 KV class transformers	Blue	5012	Signal Red	537	3001	
64.	400 KV/33 KV tie transformers	Blue	5012	Signal Red	537	3001	
65.	**GENERATOR BUST DUCT**						
	- Inside of main plant building	Blue	5012	Signal Red	537	3001	
	- Outside of main plant building	Blue	5012	Signal Red	537	3001	
66.	Generator transformer	Blue	5012	Signal Red	537	3001	
67.	Battery charger	Grey	9002	White		9010	
68.	Mimic flow diagram						

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	400 KV	Purpur Violett	4007	White		9010	
	220 KV	Signal Gleb	1003	White		9010	
	132KV	Tarkis Blau	5018	White		9010	
	33.0 KV	Oliv Grun	6003	White		9010	
	21.0 KV/15.75 KV	Beige-rot	3012				
	11.0 KV	Zink Gleb	1018	White		9010	
	6.6 KV	Enzian Blau	5010	White		9010	
	3.3 KV	Gras Grun	6010	White		9010	
	415 V	Lehm Braun	8003	White		9010	
	220V DC	Tief Orange	2011				
	Gen Fld.	Tiefsch wartz	9005				
69.	Unit Control board	Grey	9002				

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	(Control Room)						
70.	Control panel, PLC panel & UPS for CHP/AHP	Grey	9002				
71.	**MOTORS**						
	- Indoor	Blue	5012				Enamel paint to be used
	- Outdoor	Blue	5012				
72.	**LT SWITCHGEAR (INDOOR)**						
	- LT Switchgear Exterior	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- MCC	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- D.C. Distribution board	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	- L.T. busduct outside of enclosures	Blue	5012				
73.	**6.6 KV SWGR**	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- 6.6 KV busduct inside of main plant bldg.	Blue	5012				
	- 6.6 KV busduct outside of main plant building	Blue	5012				
74	**33 KV SWGR cubicle**	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- CR Panels	Grey	9002				
	- Surge protection cubicle	Grey	9002				
75.	Control and console inserts	Grey	9002				
76.	Electronic system cabinets, computer system cabinets, BMS,	Blue &	5012 &				Front & Rear Panels in Grey (RAL 9002). End Panels sides in

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	ATRS, EHC system etc. (Control equipment room)	Grey	9002				Blue (RAL 5012)
77.	All locally mounted C&I systems panel cabinets local (External)	Blue & Grey	5012 & 9002				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
78.	Intercom	Equip ment					
	- Hand sets unit	Grey	9002				
	- Hand sets plant	Grey	9002				
79	- Metal containers/ cable junction boxes	Grey	9002	White		9010	-
80.	**LIGHTING EQUIPMENT/PANELS**						
	- Exterior	Grey	9002				
81.	Unit Heaters	Grey	9002	Signal Red	537	3001	Legend in Black letters.
82.	**400 KW SWITCHYARD EQUIPMENTS**						

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	I. Control and relay panels (control equipment room and switchyard control room)	Blue & Grey	5012 & 9002				Legend in Black letters. Ends in Blue. Front & Rear in Grey.
	II. PLCC	Blue & Grey	5012 9002				Legend in Black letters. Ends in Blue. Front & Rear in Grey
83.	Switchyard CB, Isolators, CTs, PTs, Lighting arrestors, Wave Traps, CVTs, Marshalling boxes, JBs, Local Panels	Grey	9002				
84.	Porcelain parts like insulators	Brown	As per IS				Possibility of Using Grey Shade be explored.
85.	Generator Relay panels (GRP's)	Grey & Blue	9002				
86.	All other Structures and equipment.	Grey	9002				

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
87.	**INSTALLATION MATERIALS**						
	- Resin Tubes	Grey	9002				Legend in black letters.
	- Steel Tubes						Legend in black letters.
88.	Gang ways and trays	Grey	9002				Legend in black letters.
89.	Misc. steel structures (trellies, Portals, brackets)	Grey & Blue	9002 & 5012				Primary Structural in members (Columns & Beams) in Blue. Secondary members in Grey.
90.	Storage boxes	Grey	9002				Legend in black letters.
91.	**INSULATING OIL TREATMENT PLANT**						
	- Tanks and the equipment	Grey	9002	White		9010	Legend in Black Letters
92.	**IDENTIFICATIONS PLATES**						
	Mechanical equipment's and piping						
	- Background	White	9010				
	- Border	Black	9011				

EQUIPMENT

		Ground Colour		*Identification Tag/Band*			
Sl. No.	***Equipment***	***Colour***	***RAL***	***Colour***	***ISC No.***	***Equi-valent RAL No.***	***Remarks***
	- Lettering	Black	9011				

Note: 1) .For mechanical equipments ground colour indicated against each equipment shall be followed in case equipment is not insulated/cladded.

2). However if enclosure is provided for the mechanical equipments, then the indicated ground colour for mechanical equipment shall be followed.

APPENDIX-B

PIPELINES

		Ground Colour		*Identification Tag/ Band Colour*				
S. No.	***Medium***	***Colour***	***RAL***	***COLOUR***	***ISC No***	***RAL #***	***Legend***	***Remarks***
1.	**WATER**							
a.	Untreated or Raw/service	Grey	9002	Sea Green	217		RW/SW	
b.	Treated/ Demineralised	Grey	9002	Sea Green	217		DMW	
c.	Condensate	Grey	9002	Sea Green	217		MC	
i.	LP bypass spray	Grey	9002	Sea Green	217		LPBA	
ii.	Condensate Makeup line to condenser from surge tank and from DM Supply header	Grey	9002	Sea Green	217		CCM	
d.	Boiler feed	Grey	9002	Sea Green	217		BFD	
i.	HP bypass attemperation	Grey	9002	Sea Green	217		HPBA	
ii.	Super heater	Grey	9002	Sea	217		SHA	

		Ground Colour		*Identification Tag/ Band Colour*				
S. No.	***Medium***	***Colour***	***RAL***	***COLOUR***	***ISC No***	***RAL #***	***Legend***	***Remarks***
	attemperation			Green				
iii.	Reheater attemperation	Grey	9002	Sea Green	217		RHA	
iv.	Aux. PRDS attemperation	Grey	9002	Sea Green	217		APRDSA	
2.	**STEAM**							
a.	Main	Aluminium*		Signal Red	537	3001	MS	*Aluminium is to be used only in case Where the pipes are not already clad with aluminium sheets.
b.	Auxiliary	Aluminium*		Signal Red	537	3001	AS	
c.	Bled (Extraction)	Aluminium*		Signal Red	537	3001	1 EX 2 EX 6 EX	
d.	Hot reheat	Aluminium*		Signal Red	537	3001	HR	
e.	Cold reheat	Aluminium*		Signal Red	537	3001	CR	
f.	HP bypass	Aluminium*		Signal Red	537	3001	HPB	
g.	LP bypass	Aluminium*		Signal Red	537	3001	LPB	

		Ground Colour		*Identification Tag/ Band Colour*				
S. No.	***Medium***	***Colour***	***RAL***	***COLOUR***	***ISC No***	***RAL #***	***Legend***	***Remarks***
h.	Exhaust/vent (open to atmosphere) and safety valve	Aluminium*		Light Brown	537	3001	V/SVE	Hazard mark may be given
3.	**AIR**							
a.	Instrument	Grey	9002	Sky blue	101		IA	
b.	Service/Plant	Grey	9002	Sky blue	101		PA	
c.	Vacuum	Grey	9002	Sky blue	101		VC	
4.	**AIR STEAM MIXTURE**							
a.	From turbine glands to gland steam condenser	Aluminium*		Sky Blue	101		ASM	*Aluminium is to be used only in cases where the pipes are not already clad with aluminium sheets.
b.	From condenser	Aluminium*		Sky Blue	101		ASM	*Aluminium is to be used only in cases where the pipes are not already clad with aluminium sheets.

		Ground Colour		*Identification Tag/ Band Colour*				
S. No.	***Medium***	***Colour***	***RAL***	***COLOUR***	***ISC No***	***RAL #***	***Legend***	***Remarks***
c.	From heater shells to condenser	Aluminium*		Sky Blue	101		ASM	*Aluminium is to be used only in cases where the pipes are not already clad with aluminium sheets.
5.	**GAS**							
a.	Natural gas	Grey	9002	Canary yellow	309		NG	*Hazard mark is given
b.	Other fuel gas	Grey	9002	Canary yellow	309			
c.	Hydrogen	Grey	9002	Canary yellow	309		H	
d.	Nitrogen	Grey	9002	Canary yellow	309		N	
e.	Chlorine	Grey	9002	Canary yellow	309		Cl	
f.	Carbon dioxide	Grey	9002	Canary yellow	309		CO2	
g.	Non condensable gas mixtures	Grey	9002	Canary yellow	309		NCG	
h.	Oxygen	Grey	9002	Canary Yellow	309		O	
6.	**OILS**							

		Ground Colour		*Identification Tag/ Band Colour*				
S. No.	***Medium***	***Colour***	***RAL***	***COLOUR***	***ISC No***	***RAL #***	***Legend***	***Remarks***
a.	High speed diesel	Grey	9002	Light * brown	410		HSD	* Hazard Mark
b.	Furnance oil	Grey	9002	Light * brown	410		FO	* Hazard Mark
c.	Lubricating oil (including governing oil if lub oil is used for governing purposes)	Grey	9002	Light brown	410		LO	* Hazard Mark
d.	Hydraulic power	Grey	9002	Light brown	410		HYD. O	
e.	Control fluid	Grey	9002	Light brown	410		CR.O	
f.	Transformer oil	Grey	9002	Light brown	410		TR.O	
7.	**PULVERIZED FUEL**	Grey	9002	Silver grey	628		PF	
8.	**FIRE INSTAL-LATIONS**	Fire Red	536 (ISC) 3001 (RAL)	White		9010	FIRE	Legend in Red Letters over White Background

		Ground Colour		*Identification Tag/ Band Colour*				
S. No.	***Medium***	***Colour***	***RAL***	***COLOUR***	***ISC No***	***RAL #***	***Legend***	***Remarks***
9.	**CHEMICAL FEED**							
a.	HP dosing to boiler (Phosphate)	Grey	9002	Dark admiralty grey	632		HCF	Legend in Black Letters
b.	LP dosing to condensate (Hydrazine/ Ammonia)	Grey	9002	*Signal Red	537	3001	LCF	*Hazard mark is given
10.	**ACID PIPING** (in water treatment plant)	Grey	9002	*Signal Red	537	3001	+	+Name of the chemical (formula) to be used as legend for identifying the individual acids & alkalies
11.	**ALKALI PIPING** (in water treatment plant)	Grey	9002	*Signal Red	537	3001		*Hazard mark is given
12.	**ASH PIPE**	Grey	9002	French Blue	166		ASH	
13.	**IMPULSE PIPING**	Grey	9002	Same as process piping				

Note : Ground colour indicated against each piping shall be followed in case piping is not insulated /cladded.

NOTE: FOR PAGE 27, GO TO PAGE NO.3, CLAUSE NO.5.4 AND CLICK ON Appendix-C WHICH IS HYP