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T E N D E R S P E C I F I C A T I O N

TENDER NO. BHEL: NR (SCT): BAWANA: HRSG: 604

FOR

Erection, Testing, Commissioning, Trial Operation and Handing over of 4 x 272 TPH HRSG with related auxiliaries & piping at 1500 MW Pragati-III CCPP at Bawana, Delhi

PART I – TECHNICAL BID

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

ISO 9001-2000, ISO 14001 and OHSAS 18001 certified company
SubContract and Purchase Deptt.

Bharat Heavy Electricals Limited
(A Govt. Of India Undertaking)
Power Sector – Northern Region,
Plot No. 25 , Sector - 16A ,
Distt. Gautam Budh Nagar, NOIDA – 201 301.INDIA
Phone: 0091-0120-2515476 / 2515464 / 2515479
Fax 091-0120-2515464 / 2515467
Email: sku@bhelpsnr.co.in / pshiv@bhelpsnr.co.in

TENDER NO. BHEL: NR (SCT): BAWANA: HRSG: 604

IMPORTANT NOTE

PURCHASER OF THIS TENDER DOCUMENT IS ADVISED TO CHECK AND ENSURE COMPLETION OF ALL PAGES OF TENDER DOCUMENT AND REPORT ANY DISCREPANCY TIMELY FOR CORRECTIVE ACTION, IF ANY, TO THE ISSUING AUTHORITY BEFORE THE BIDS ARE SUBMITTED. ORIGINAL COPY OF TENDER DOCUMENT COMPLETE IN ALL RESPECTS MUST BE SUBMITTED BACK AS PART OF THE BID WITHOUT WHICH THE SAME IS LIABLE TO BE REJECTED BY BHEL.

THIS TENDER SPECIFICATION ISSUED TO:

M/S----------

INDEX

ISO 9001-2000, ISO 14001 and OHSAS 18001 certified company SubContract and Purchase Deptt.

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TENDER NOTICE

Sealed tenders are invited from the contractors fulfilling qualifying requirements for the "Erection, Testing, Commissioning, Trial Operation and Handing over of 4 x 272 TPH HRSG with related auxiliaries & piping at 1500 MW Pragati-III CCPP at Bawana, Delhi"

TENDER NO. BHEL: NR (SCT): BAWANA: HRSG: 604

QUALIFYING REQUIREMENTS:

"Tenderers who wish to participate should fulfill following 'Qualifying Requirements";

1.1 Tenderer who wish to participate should have carried out during the last Seven years, erection and commissioning work of atleast one boiler (for thermal unit of 67.5 MW or higher rating) or alternatively atleast one HRSG of 200 TPH or higher rating units.

'OR'

1.2 "Should be executing works of similar nature, as covered in this tender against direct BHEL's order for one HRSG of 272 TPH or higher rating units.

'AND'

1.3 Party should also have an average annual turnover of minimum of Rs. 2060 lacs (Rupees Two Thousand Sixty Lacs Only) during preceding three years (2005-06, 2006-07 & 2007-08). Tenderer shall submit audited balance sheet in support of above.

1.4 Bidders selection is subject to approval of BHEL's customer i.e. M/s PPCL/ NTPC for this work.

NOTES:

(i) The Tender Documents comprise of following;
(a) General Conditions of Contract
(b) Special Conditions of Contract, Tender Notice, Project Synopsis etc.
(c) Rate Schedule

(ii) Tender Documents with complete details are hosted in this web page. Bidder(s) intending to participate may download the tender document from the web site. Bidder(s) downloading the tender documents from the web site, shall remit Rs.1000/- (Rupees One thousand only) in the form of crossed demand draft (non-refundable), in favour of BHEL, NOIDA along with their offer.

(iii) Bidder(s) can also purchase hard copy of tender documents from this office. Tender documents (non transferable) will be issued on all working days between 09.30 Hrs. to 12.30 Hrs within the sale period i.e ***upto 02.03.2009*** on payment of Rs.1,000/- (non-refundable) either in cash or by crossed demand draft in favour of BHEL, NOIDA. Request for issue of tender document should clearly indicate Tender No. and work.

(iii) Tenders must be submitted to the undersigned in Room No. 104 **latest by 15:00 Hrs. on *03.03.2009.*** Technical bids shall **be opened at 15.30 Hrs. on *03.03.2009***.

(iv) Earnest Money Deposit (EMD) : Refundable, Non-interest bearing **EMD of *Rs 2,00,000/-*** shall be deposited by Account Payee Pay Order 'OR' Demand Draft in favour of " Bharat Heavy Electricals Limited" payable at Delhi/NOIDA . Those bidders who have already deposited ' One Time 'EMD' of Rs. 2,00,000/- with BHEL, PSNR, NOIDA need not submit EMD with the present tender.

(v) Tenders not accompanied with Full Earnest Money Deposit, as indicated above, will not be considered.

(vi) All corrigenda, addenda, amendments and clarifications to this Tender will be hosted in this web page and not in the newspaper. Bidders shall keep themselves updated with all such amendments.

(vii) BHEL reserves the right to accept or reject any or all tenders without assigning any reason whatsoever.

(viii) BHEL takes no responsibility for any delay/loss of documents or correspondences sent by courier/post.

(ix) Purchase Preference will be given to CPSUs as per Govt. Guidelines.

(x) **BHEL reserves the right to go for a Reverse Auction instead of Opening the submitted sealed bid, which will be decided after technical evaluation. As such, the bidders should submit their best prices in the 'Sealed Price Bid'. However, bidders are required to confirm their acceptance of "General terms and conditions" governing RA specifically in their technical bid. The "General terms and conditions" governing RA are given in the SCC of the NIT. Bidders are also required to furnish following details in their techno-commercial bid, for this purpose (RA).**

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

1. Name and Designation of official
2. Postal Address (Complete)
3. Telephone Nos. (Land line & Mobile both)
4. FAX No.
5. E-mail address
6. Name of Place/State/Country, wherefrom he will participate in the RA

(xi) **Unsolicited rebate / discount shall not be accepted after bid opening.**

DGM/SCP

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DOMESTIC NOTICE INVITING TENDER

LAST DATE OF SALE : *02.03.2009*
DUE DATE OF SUBMISSION : 03*.03.2009 (15:00 Hrs.)*
DATE OF OPENING : 03*.03.2009 (15:30 Hrs.)*

NIT NO. / NAME OF WORK
TENDER NO. BHEL: NR (SCT): BAWANA: HRSG: 604 **Sealed tenders are invited from the contractors fulfilling qualifying requirements for the "Erection, Testing, Commissioning, Trial Operation and Handing over of 4 x 272 TPH HRSG with related auxiliaries & piping at 1500 MW Pragati-III CCPP at Bawana, Delhi."**

NOTES

1. Purchase Preference will be given to CPSU as per Govt. Guidelines.
2. Please visit our website at www.bhel.com for details of NIT including Qualifying Requirements.

DGM/SCP

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PROCEDURE FOR SUBMISSION OF SEALED TENDERS:

The tenderers must submit their tenders as required in **two parts** in separate sealed covers **prominently superscribed as Part-I Technical bid and Part-II ,Price bid** also indicating on each of the cover tender specification no., date and time as mentioned in tender notice.

TECHNICAL BID (COVER-I)

Except **Price bid Part-II**, complete set of tender document consisting of General conditions of Contract, "Technical specification & Special terms and condition" (Part-I) issued by BHEL shall be enclosed in **Part I Technical Bid only**. All schedules, data sheets and details called for in the specification shall also be submitted along with technical bid. All details / Data / Schedules including offer letter duly signed and stamped are to be **submitted in duplicate**.

PRICE BID (COVER-II)

Tenderers may please note that price bid is **to be submitted only in original copy** of Tender i.e. Price bid (Part-II) issued by BHEL and no duplicate copy of same is required.

These Two separate covers i.e. cover I & II shall together be enclosed in a **third envelope (Cover-III)** and this sealed cover shall be superscribed with tender specification No., due date, time and submitted to officer inviting tender as indicated in tender notice on or before due date as indicated.

PROJECT SYNOPSIS

1.	Name of the Owner	:	Pragati Power Corporation Limited (PPCL)
2.	Address	:	Pragati III CCPP Bawana Delhi
3.	Installed capacity	:	New project
4.	New Installation	:	1500 MW (Nominal)
5.	Nearest Railway station	:	Delhi
6.	Nearest City	:	Delhi
7.	Nearest Airport	:	Delhi
8.	Maximum Temperature	:	48 Deg C
9.	Minimum temperature	:	Appx 2 Deg C

SECTION-III (PART-A)

SPECIAL CONDITIONS OF CONTRACT

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SECTION-III (PART-A)

SPECIAL CONDITIONS OF CONTRACT

34.0 **GENERAL**

34.1 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 / lumpsum price shall deem to be inclusive of all such contingencies.

34.2 The contractor shall carry out the work in accordance with standard practices / codes/ instructions /drawings/ documents/ specification supplied by BHEL from time to time to the satisfaction of owner of the project.

34.3 The work shall conform to dimensions and tolerances given in various drawings and documents that will be provided during erection. 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 bills towards expenditure incurred including BHEL's usual overhead charges.

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

(a) Provision of all types of labour, supervisors, Engineers, watch and ward as required, tools & tackles, calibrated inspection, measuring and test equipment as specified and otherwise required for the work and consumables for erection, testing and commissioning including material handling.

(b) Proper out-turn as per BHEL plan and commitment.

(c) Completion of work as per BHEL Schedule.

(d) Good quality and accurate workmanship for proper performances of equipment.

(e) Repair and rectification.

(f) Re-conservation / preservation of all components during storage / erection till handing over.

34.5 BHEL-Power Sector (NR) is ISO 9001-2000, ISO 14001-1996, OHSAS 18001-1999, ISO 27001 and SA-8000 certified company. Quality of work, to customer's satisfaction and system requirements is the essence of these certifications. The contractor in all respects will organize his work, systems, environment, process control documentation, tools, plant, inspection, measuring and testing equipments etc. as per instructions of BHEL engineer. The contractor shall also comply with applicable legislation and regulations with regards to Health, Safety and Environmental aspects for minimizing risk arising from occupational health & safety hazards, controlling pollution and wastage. The Contractor will be responsible for Health, Safety & Environment management (HSE) at site for the construction activities to be carried out by them in accordance with requirements given under section I (a) of GCC and

elsewhere in this tender document. The contractor, who is awarded the work, shall have to sign an MOU w.r.t implementation of HSE conditions with BHEL (Safe Work Practices)**..**

34.5.1 Besides provision with regard to SAFETY under Clause 27 of GCC, the contractor will be responsible for Health, Safety & Environment management at site for the construction activities to be carried out by them in accordance with requirements **given under section I(a) of GCC of this document**. The contractor shall continuously take special care to ensure the safety and prevention of human and equipment accidents and maintain good sanitary conditions in and around the site. All the construction work and plant operation must be carried out in the safest possible manner. The Engineer reserves the right to stop any process which, in the Engineer's opinion, is being performed dangerously. In this case the contractor must immediately adhere the requisite safety precautions and any delays attributed to the work stoppage on this account shall not affect the agreed contractual finishing dates.

The contractor shall appoint dedicated full-time Qualified Safety Officers who shall have full authority to ensure that all necessary safety precautions are observed by the Contractor's employees and sub-contractors. These appointees shall have full responsibility for the safety of all personnel within the contractor's area of the works.

34.5.2 Some of the common safety rules to be followed during working are as follows **:-**

- No body is allowed to enter at construction site without Safety Shoe.
- Never enter work area without Safety helmet & chin strap in place.
- No climbing/working allowed without proper safety belt above 2 m. height.
- Do not exceed the speed limit 25 Kmph within premises.
- No debris obstacles allowed on the roads & passages.
- Do not walk on pipelines or false ceiling.
- Maintain good Housekeeping at work site.
- No photography/ Videography allowed without permission
- All Site supervisors & engineers (including subcontractor's) must be imparted structured training on construction safety before start of the job & record to be maintained.
- Availability of qualified & trained Site Engineer at site during all working hours.
- Site Safety training to be imparted to all workers & plan to be made to cover every worker.
- Tools box talk (5-15 minutes) by supervisor prior to commencement of any job.
- All accident / incidents(Near Miss) to be reported & investigated.(formats & procedure should be finalized)
- Daily Safety Checking by Each Site Engineer along with Safety engineer.
- Weekly co-ordination meeting of all Safety engineers with BHEL safety officer.
- Monthly safety meeting with Site In-charges.
- All Safety equipment must be ISI marked & checked by Safety officer before use.
- Tag system for erection & use of scaffoldings.
- Bamboo/wooden Scaffolding material not allowed.
- LPG cylinders not allowed for gas cutting.
- Good House keeping. Separate waste bins to be used for flammable & non flammable material.
- Safety awareness programs for workers by display of boards, posters, competitions, talks etc.
- Deployment of Safety Supervisors for every 250 workers and part there of at work site.
- Display of List of First Aid trained persons.

- Testing certificates for lifting tools & tackle.
- Provision & maintenance of fire extinguishers at construction site & material stores.
- Display of emergency telephone numbers at various locations.
- For work in confined space use 24 V lamp fitting & use tools with air motors or electric tools with max. 24 V.
- For confined space entry Gas test must be done before & at regular intervals.
- Checking & tag of equipment like grinding machine, welding machine, gas cutting set etc. by supervisors before use.

Further, the contractor is required to provide proper Safety Net System wherever the hazard of fall from height is present as per instructions of BHEL Engineer at site. The safety net shall be fire resistant, duly tested and shall be of ISI mark and the nets shall be located as per site requirement to arrest or to reduce the consequences of a possible fall of persons working at different heights.

34.5.3 Contractor shall ensure following:

1. Contractor has to maintain contact with local hospital having ambulance facility , scanning & other ultra modern medical facilities required during emergency.

2. Contractor has to ensure pre employment medical check for all staff & workers.

3. Contractor has to ensure that adequate First Aid facilities with trained nurse are available at work site for emergency purpose. This emergency set-up should include, but not limited to, following

- Male nurse (in shifts)
- Oxygen set up
- Breathing apparatus
- Eye wash facility
- Stretcher
- Trauma blanket
- Medicines.

In addition to above, BHEL (through its other contractor) has arranged ambulance at work site for emergency purpose, which can be utilized by contractor in case of emergency.The charges for the same will be decided mutually at site . In case , under unavoidable circumstances , if the ambulance is not available , the contractor will have to arrange for the same as under clause 34.5.3 (1).

34.5.4 The Contractor shall be fully responsible for accidents caused due to him or his agents or workmen's negligence or carelessness in regard to the observance of the safety requirements and shall be liable to pay compensation for injuries. **It may be noted that non-compliance to HSE requirements will result in penal action. In case of violations of safety requirements, the Contractor shall be liable for a penalty of Rs. 200/- for the first violation and Rs. 500/- for the subsequent violations. For serious lapses, as decided by BHEL Engineer, fines upto Rs. 5000/- at a time can be imposed.**

The amount towards penalties as above will be deducted from running bills of the Contractor. The amount so collected above will be utilized for supporting the safety activities at site. The decision of BHEL on above will be final and binding on the Contractor.

34.5.5 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 Discrimation/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.

34.5.6 In order to meet the environmental concerns it is expected that the contractor shall plant, protect and maintain 300 trees in the vicinity of the project as per the available space and as per the advise of Engineers. In case no area is earmarked for tree plantation, the contractor may take up any other equivalent environment related project after due approval of the BHEL Engineer.

35.0 CIVIL WORKS, FOUNDATIONS AND GROUTING

35.1 Foundation for all equipment and steel structure and necessary civil works, including grouting shall be provided by BHEL / Customer. The dimensions and locations of the foundations, pockets, anchor bolt pitch shall be checked by the contractor for their correctness as per drawings. The top elevation of foundations shall be checked with respect to bench mark etc. All minor adjustments of foundation level, dressing and chipping of foundation surfaces up to 50mm, enlarging the pockets in foundations etc., increasing the existing floor opening for cable entry, fixing panels and repair of same as may be required for the erection of equipment / panels shall be carried out by the contractor within the tonnage rate.

35.2 Entire grouting work of foundation bolt grouting, base plate grouting etc. including materials will be carried out by another agency carrying out Civil work for BHEL. Contractor for subject work has to offer neat & clean foundations to the Civil Contractor to ensure perfect grouting.

35.3 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 packing plates as per requirements provided it is allowed by BHEL Engineer. The embedded sub sole plates shall be corrected and checked with Prussian blue to get the required level and contact with frames.

35.4 The contractor shall ensure perfect matching of structure/ equipment, 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 structural column and equipment to the satisfaction of BHEL Engineer. BHEL at its discretion can accept rough chipping of foundations, embedding packer plates in cement mortar etc.

35.5 While grouting will be carried out by BHEL Civil contractor, contractor shall keep all the matching joints, which are not to be grouted, free from the grouting mixture by applying tape or any other alternative method approved by Engineer.

35.6 The contractor shall check and verify the alignment of equipment, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during post grouting check up and verifications. Such pre and post grout records of alignment details shall be maintained by the contractor in a manner acceptable to the Engineer.

35.7 Besides grouting as above, any civil works required for safe and efficient operation of tools and tackles, like grouting/excavation /casting of foundation / anchor points for derricks, winches, guy ropes fastening, etc. any other temporary supports shall also be the contractor's responsibility. For these civil works all materials including cement and required facilities will have to be arranged by contractor at his own cost.

36.0 CONSUMABLES

36.1 The contractor shall provide within finally accepted rates, all consumables like all welding electrodes (including alloy steel and stainless steel), TIG filler wires (over & above as supplied by the unit along with the plant materials, which will be given free of cost to bidder), all inert / welding & cutting gases, soldering material, dye penetrates, radiography films, tapes, jointing compound, grease, mobile oil, M-seal, Molecote Areldite, petrol / other cleaning agents, wooden sleepers, steel required for temporary works such as platforms, scaffoldings, ladders, lapping compound, sealing compound etc., required for completion of work except those which are specifically supplied by manufacturing unit.

36.2 All the shims & gaskets which go finally as part of equipment shall be supplied by BHEL free of cost.

36.3 It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of consumables. Non availability of any consumable materials or equivalent suggested by BHEL cannot be considered as reason for not attaining the required progress or for additional claim.

36.4 It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of electrodes etc. before procurement of welding electrodes / TIG wires. On receipt of electrodes at site these shall be subjected to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch No. date of expiry etc. and produce test certificate for each lot / batch with correlation of batch / lot no. with respective test certificate. No electrode will be allowed to be used without valid test certificate.

36.5 BHEL reserves the right to reject the use of any consumable including electrodes, gases, lubricants / special consumables if it is not found to be of the required standard / make / purity or when shelf life has expired. Contractor shall ensure display of shelf life on consumable wherever required and records maintained.

36.6 Storage of all consumables including welding electrodes shall be done as per requirement / instruction of the Engineer by the contractor at his cost including arrangements for the same.

36.7 In case of improper arrangement for procurement of any consumable, BHEL reserves the right to procure the same from any source and recover the cost from the Contractor's first / subsequent bill at market value plus the departmental charges of BHEL as applicable from time to time (30% at present). Postponement of such recovery is normally not permitted. The decision of Engineer in this regard shall be final and binding on the Contractor.

36.8 All lubricant and chemicals required for cleaning, pre-commissioning, commissioning, testing, preservation and lubricants for trial runs of the equipment shall be supplied by BHEL. All services including labor and T&P will be provided by the contractor for handling, filling, emptying, refilling etc. The consumption of lubricants / chemicals shall be properly accounted for. Surplus material if any shall be properly stacked and returned to BHEL/ CUSTOMER stores at no extra cost to BHEL

37.0 TOOLS AND PLANTS / IMTES

37.1 T&P being provided by BHEL to sub-contractor free of hire charges (**as per Annexure-II)** shall be shared by other sub contractors working for BHEL at site and the allotment done by BHEL Engineer shall be final and binding.

37.2 Besides the T&P being made available to contractor free of hire charges by BHEL, all other T&Ps and IMTEs which are required for successful and timely execution of the work covered within the scope of this tender, shall be arranged and provided by the contractor at his own cost. Indicative lists of T&Ps and IMTEs to be arranged by the contractor are given **as per Annexure-III & IV** Contractor should ensure that these are in good working condition. In the event of the failure of contractor to bring necessary and sufficient T&Ps and IMTEs, BHEL will be at liberty to arrange the same and hire charges as applicable shall be deducted from contractor's bill. Decision of BHEL in this regard shall be final and binding on contractor.

37.3 All distribution boards, connecting cables, wire ropes, hoses, pipes etc. including temporary air / water/ electrical connections etc. shall have to be arranged by the contractor at his own cost.

37.4 In case of non-availability of the T&Ps to be provided by BHEL due to breakdown, major overhauls, distribution pattern or any other reason, the contractor shall plan / amend / alter his activities to meet erection / commissioning targets in consultation with BHEL.

37.5 The **operation** of all BHEL's cranes **(Except for 200/250 MT cranes)** being provided free of hire charges shall be in the scope of the contractor. The contractor shall arrange, at his own cost, trained operators and fuel and other minor consumables (i. e. cotton cloth / cotton waste etc.) for their operation. **(Operator only for 200/250 MT cranes will be provided by BHEL). Further, Helpers and fuel for operation of all BHEL cranes shall be provided by contractor within the final accepted rates).**

All Lubricants for the BHEL cranes such as mobil oil, gear oil, brake oil, hydraulic oil, torque converter oil and grease will be provided by BHEL free of cost. The contractor will give the requirement well in advance.

37.6 The contractor shall engage trained and experienced operators for the operation of BHEL's T&Ps. Their skill / performance will be checked by BHEL Engineer before they are allowed to operate the same. However checking of skills by BHEL does not absolves contractor of his responsibilities for proper and safe handling of equipment. Consistent good performance of operators and regular performance evaluation of operators shall be ensured by the contractor.

37.7 The day to day **operation and maintenance** of BHEL's T&Ps **(Other than cranes)** shall be carried out by contractor as per manufacturer's / BHEL's maintenance schedule at his cost. These shall be maintained in good working condition during the entire period of use. T&Ps in defective / damaged condition shall be rectified promptly to the full satisfaction of BHEL Engineer. Contractor shall maintain records for maintenance of major T&Ps, which shall be made available for Inspection whenever required. In case of any lapses on the part of the contractor BHEL at its own discretion get the servicing / repair of equipment done at the risk and cost of the contractor with BHEL overheads.

37.8 **Maintenance of BHEL cranes (100 MT and above), will be carried out by a separate agency appointed by BHEL.** However, the helpers for day today maintenance and fuel for these cranes shall be in the scope of this contract.

For Maintenance of BHEL cranes (less than 100 MT), while these shall be covered under AMC awarded by BHEL, the contractor at his own cost shall arrange all supervision and labour required for routine / day-day maintenance of cranes. For attending breakdowns of these cranes, the contractor shall arrange for labour. A separate maintenance group to be formed by the contractor for the day today maintenance of all the T & P,s working at site. However specialist's supervision, for attending breakdowns shall be arranged by BHEL as assessed by BHEL Engineer. Repair of self and dynamo shall be the responsibility of the contractor. The cranes shall be fitted with a set of new batteries at the time of initial issue from the stores. However, the charges of the replacement of the other damaged / worn out parts of BHEL cranes will be borne by BHEL, provided the damage is not due to the negligence of the contractor.

All the spares & lubricants (except for diesel) for the cranes (BHEL's Cranes) shall be supplied by BHEL. For all BHEL cranes , if there are breakdowns / damages due to negligence of the contractor, the complete service / repair charges and cost of all the spares damaged with BHEL overheads shall be recovered from contractor's RA bills.

37.9 Spares needed for upkeep of BHEL's T&Ps shall be supplied by BHEL. Repair of self, dynamo, battery and electric wiring of BHEL's T&P's shall be the responsibility of the contractor. The charges of the replacement of the other damaged / worn out parts of BHEL cranes will be borne by BHEL, provided the damage is not due to negligence of the contractor. However, if there are breakdowns / damages due to negligence of the contractor, the complete service/ repair charges and cost of all the spares damaged with BHEL overheads shall be recovered from contractor's RA bills.

37.10 Increasing / shortening of the crane boom to suit work requirements shall have to be arranged by the indenting contractor at his cost. All necessary manpower, tools, support, consumables, illumination etc. will have to be arranged by contractor at his cost.

37.11 The area and infrastructure development of area to be carried out by the BHEL / customer. However in construction projects of this magnitude it is possible that all the areas/ approaches may not be ready. In such cases consolidation of ground and arrangement of sleepers / sand bag filling etc. for safe operation / movement of equipment including cranes / trailers etc. shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable.

37.12 In the event of contractor not using and maintaining BHEL T&Ps according to BHEL's instructions, BHEL will have the right to withdraw such item without any notice and no

claim in this regard shall be entertained and contractor shall be responsible for delay in execution on this account.

37.13 The contractor shall furnish regular utilisation report of the BHEL's T&Ps as per requirement of BHEL.

37.14 Any loss / damage to any part of BHEL T&Ps shall be to the contractor's account and any expenditure on these accounts by BHEL will be recovered from the contractor's bill in case the contractor fails to make good the loss.

37.15 It shall be responsibility of the contractor to take delivery of T&Ps and IMTEs from stores or place of use by other contractor at project site, transport the same to site and return the same to BHEL / its Customer's store/ place as intimated by BHEL Engineer in project site in good working conditions after use.

37.16 Replacement cost including BHEL's overhead in respect of irreparable / completely damaged / non return of T&Ps shall be recovered from the contractor's running bills.

37.17 The contractor shall return BHEL's / its Customer's T&Ps and IMTEs issued to him in good working condition as and when desired by BHEL. If return of T&P and IMTE is delayed by contractor, hire charges as applicable shall be levied by BHEL from time, it was requisitioned till the time of actual return. Hire charges shall also be charged on the T&Ps and IMTEs returned in damaged / unserviced condition to BHEL/ its customer till its satisfactory repair. T&Ps and IMTEs returned in damaged / unserviced condition shall be got repaired by BHEL at its own discretion and entire cost of repair with BHEL overheads shall be recovered from the contractor.

37.18 Contractor shall ensure deployment of serviced and healthy T&Ps including cranes, lifting tackles, wire ropes, Manila ropes, winches and slings etc. History card and maintenance records for major T&Ps will be maintained by the contractor and will be made available to BHEL Engineer for inspection as and when required. Identification for such T&Ps will be done as per BHEL Engineer's advice.

37.19 Contractor shall ensure deployment of reliable and calibrated IMTEs (Inspection measuring and Test equipment). The IMTEs shall have test/ calibration certificates from authorised/ Govt. approved / accredited agencies traceable to National / International standards. Each IMTE shall have a label indicating calibration status i.e. date of calibration, calibration agency and due date for calibration. A list of such instruments deployed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.

37.20 Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer with in the contract price. The contractor will also have alternate arrangements for such IMTE so that work does not suffer when the particular instrument is sent for calibration. Also if any IMTEs not found fit for use, BHEL shall have the right to stop the use of such item and instruct the contractor to deploy proper item and recall i.e. repeat the readings taken by that instrument, failing which BHEL may deploy IMTEs and retake the readings at contractor's cost.

37.21 BHEL shall have lien on all T&PS, IMTEs & other equipment of the Contractor brought to the Site for the purpose of erection, testing and commissioning. BHEL shall continue to hold the lien on all such items throughout the period of Contract. No material brought to the Site shall be removed from the site by the Contractor and / or his Sub-contractors without the prior written approval of the Engineer.

37.22 The month-wise T&P deployment plan to be submitted as per format (at Annexure-D to general conditions of contract) is only to assess the capability as well as understanding of the contractor to execute the work. It shall be the contractor's responsibility to deploy the required T&P, for timely and successful completion of the job, to any extent over and above those indicated in the above deployment plan (including those which are not covered in the plan submitted) without any compensation on this account.

38.0 SUPERVISORY STAFF AND WORKMEN

38.1 The contractor shall deploy all the skilled / certified workmen like Mill Wright fitters, welders, gas cutters, crane operators, drivers, riggers, sarangs, masons, carpenters, electricians, instrument technicians etc., in addition to other skilled, semi-skilled and unskilled workmen required for all the works of unloading, handling, storage and transportation from site storage to erection site, erection, testing and commissioning as contemplated under these specification. Only fully trained and competent men with previous experience on the job shall be employed. They shall hold valid certificates wherever necessary. BHEL reserves the right to decide on the suitability of the workers and other personnel who will be deployed by the contractor. BHEL reserves the right to ask for removal of any employee workman of the contractor at any time, if they find him unsuitable for any reason and the contractor shall remove him immediately without discussions on the reasons.

38.2 The supervisory staff including qualified Engineers deployed by the contractor shall ensure proper out-turn of work and discipline on the part of the labour put on the job by the contractor and in general see that the works are carried out in a safe and proper manner and in coordination with other labour and staff deployed directly by BHEL or other contractors of BHEL or BHEL's client / other agency.

38.3 The contractor shall deploy the necessary number of qualified and approved full time electricians at his cost to maintain his temporary electrical installation till the completion of work.

38.4 The work shall be executed under the usual conditions affecting major power plant construction and in conjunction with numerous other operations at site. The contractor and his personnel shall cooperate with other personnel/ contractor, coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

38.5 The contractor's supervisory staff shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and aesthetic finish are essential part of this contract. The contractor shall be responsible to ensure that assembly and workmanship conform to the dimensions and tolerances given in the drawings/documents/ instructions given by BHEL Engineer from time to time.

38.6 It is the responsibility of the contractor to engage his workmen in shifts or on overtime basis for achieving the targets set by BHEL and also during the period of commissioning and testing of unit. The contractor's finally accepted rates / prices shall include all these contingencies.

38.7 During the course of erection,

- if the progress is found unsatisfactory.
- if the target dates fixed from time to time for every mile stones are to be advanced / not being met.

- if it is found that the skilled workmen like fitters, operators, technicians etc. deployed are not sufficient.

BHEL after giving reasonable opportunity to the contractor will induct on the work the required workmen in addition to the contractor's workmen to improve the progress. The expanses so incurred shall be recovered from the contractor's bills with applicable overheads.

38.8 If the contractor or his workmen or employees shall break, deface, injure or destroy any part of a building, road kerb, fence, enclosure, water pipes, cables, drains, electric or telephone posts or wire, trees or any other property or to any part of erected components etc., the contractor shall make the same good at his own expense or in default, BHEL may cause the same to be made good by other workmen or by other means and deduct the expenses (of which BHEL's decision is final) from any money due to the contractor.

38.9 Though every endeavor shall be made to ensure that all plant materials are supplied as per schedule. However in a job of this kind it is possible that some materials may be delayed. In order to achieve the ultimate targets, the contractor may have to augment his manpower and resources. No compensation on this account shall be admissible

38.10 The month wise manpower deployment plan to be submitted as per format (at Annexure-C to General Conditions of Contract) is only to assess the capability as well as understanding of the contractor to execute the work. It shall be the contractor's responsibility to deploy the required manpower, for timely and successful completion of the job, to any extent over and above those indicated in the above deployment plan (including those which are not covered in the plan submitted) without any compensation on this account. Separate certified persons shall be identified at site for quality control and safety by the contractor.

39.0 MATERIAL HANDLING AND STORAGE

39.1 All the equipment/ material furnished under this contract shall be received from the project stores, sheds / storage yards & transported to pre assembly area / erection site & stored in the storage spaces in a manner so that they are easily retrievable till the contractor erects them.

39.2 The contractor shall take delivery of components / equipment from storage area after getting the approval of BHEL Engineer on standard indent forms. It shall be contractor's responsibility to assist BHEL in identifying materials well in time for erection, taking delivery of the same, following the procedure indicated by BHEL, and transport the material safely to pre-assembly yard /erection site in time, according to programme. While drawing/ lifting material from BHEL / customer stores, contractor shall ensure that the balance / other materials are stacked back immediately at no extra cost to BHEL. Some of the consignment may have to be unloaded in the assembly area and at or near erection site directly from truck / trailer, the procedure for handling this material too will be same as for the material received in stores and as advised by BHEL Engineer.

39.3 The contractor shall identify and deploy necessary Engineers/ supervisors / workmen for the above work in sufficient number as may be needed by BHEL, for areas covering their scope.

39.4 All the equipment shall be handled very carefully to prevent any damage or loss. No untested wire ropes/ slings etc. shall be used for unloading / handling. The equipment shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the stores shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.

39.5 Contractor shall ensure that while lifting slings shall be put over the points indicated on the equipment or as indicated in the manufacturer's drawings. Slings/ shackles of proper size shall be used for all lifting and rigging purposes. All care shall be taken to safe guard the equipment against any damage. In no case piping should be dragged. In case of any damage due to mishandling, the cost shall be recovered from the contractor.

39.6 Approach road conditions from the stores / yards to the erection site may not be equipped and ideal for smooth transportation of the equipment. Contractor may have to be adequately prepared to transport the materials under the above circumstances at no extra cost to BHEL

39.7 Contractor shall be responsible for examining all the plant material issued to him and notify the Engineer immediately of any damage, shortage, discrepancy etc. before they are moved out of the stores/ storage area. The contractor shall be solely responsible for any shortages or damages in transit, handling, storage and erection of the equipment once received by him. As the erection work will be spread in different areas / locations of the project, contractor has to arrange sufficient no. of watch / ward personal to avoid any pilferage of material. As per General Conditions of contract under provisions of clause No 29, BHEL will reserve the right to recover the cost of repair / replacement, if any, to bring back the equipment in original order, in case the equipment / material is lost / damaged while in the custody of the contractor. BHEL's decision in this regard shall be final and binding on the contractor.

39.8 The contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the engineer at any time.

39.9 All the material in the custody of contractor and stored in the open or dusty locations must be covered with suitable weather proof / fire retardant covering material wherever applicable and shall be blocked up on raised level above ground. All covering materials including blocks and sleeper shall be arranged by the contractor at his cost.

39.10 If the material belonging to the contractor are stored in area other than those earmarked for his operation the engineer will have the right to get it moved to the area earmarked for the contractor at the contractors risk and cost.

39.11 The contractor shall be responsible for making suitable indoor storage facilities to store all equipment (drawn by the contractor from BHEL / customer stores) which require indoor storage till the time of their installation. The Engineer will direct the contractor in this regard, which item in his opinion will require indoor storage, and the contractor shall comply with Engineer's decision

39.12 The contractor shall ensure that all surplus / damaged / scrap / unused material, packing wood / containers/ special transporting frames etc. are returned to BHEL / Customer at a place in project area identified by the Engineer. The contractor for all such items received and returned to BHEL/ Customer will maintain an account. Contractor will stack the daily removed packing material at one place and shift the same weekly or at such frequency to it's final location (including weighing of the same within the Refinery area if required), as decided by BHEL Engineer / customer.

39.13 The contractor shall return all surplus materials with proper identification tags to BHEL / BHEL's client stores as per advise of BHEL Engineer.

39.14 It shall be the responsibility of the contractor to keep the work / storage areas in neat, tidy and working conditions. All surplus / unusable packing and other materials shall be removed and deposited at location(s) specified by BHEL within the project premises. If required weighing of the same within the project premises will have to be carried out.

40.0 PRESERVATION OF COMPONENTS

40.1 After taking delivery from BHEL's / customer's stores, plant materials storage shall be subjected to the following protection besides other provisions indicated in these specifications elsewhere.

a) Items stored outdoors shall be stored in such a way that item is at least six inches (6") above the ground

b) Motors, valves, electrical equipment, control equipment and instruments etc. shall be stored indoors in warehouse provided by contractor.

c) Bearings and other wearing surfaces of plant materials shall be protected against corrosion and kept clean.

d) Insulation materials shall be stored indoors or otherwise protected against getting wet.

40.2 It shall be the responsibility of the contractor to apply preservatives / touch up paints (primer) on equipment handled and erected by him till such time of final painting. It shall be contractor's responsibility to arrange for required paints (Primer), labour, scaffolding materials, cleaning materials like wire brush, emery sheets, etc., cleaning of surface and provide one coat of preservatives / paints (primer) from time to time as decided by BHEL engineer. The accepted rate shall include this work also. It is to be noted that such painting may have to be done as and when required till such time the final painting is carried out.

40.3 A separate gang of minimum two persons with all the necessary paints (Primer) / preservatives, scaffoldings and other arrangements shall be provided by the contractor within the finally accepted rate.

40.4 The contractor shall effectively protect the finished work from action of weather and from damage or defacement and shall cover the finished parts then and there for their protection.

41.0 ERECTION

41.1 All the Fixtures including omega lugs etc., scaffolding materials, concrete block supports, steel structures required for temporary supporting, preassembly, installation, welding, lifting and handling or checking etc during pre-assembly and erection shall be arranged by contractor at his cost.

41.2 It shall be contractor's responsibility to check the various equipment foundations for correctness with respect to level, orientation, dimensions etc. and ascertained dimensions shall be measured and submitted to BHEL for approval before erection.

41.3 All works such as cleaning, checking, leveling, blue matching, aligning, assembling, welding, temporary erection for alignment, dismantling of certain equipment for checking / cleaning, surface preparation, fabrication at site, cutting, grinding, straightening chamfering, filing, chipping, drilling, reaming, scrapping, machining, surface grinding, shaping, fitting up including NDT & PWHT etc. as may be applicable in such erection works are to be treated as incidental to erection and necessary to complete the work satisfactorily and shall be carried out by the contractor as part of the work.

41.4 HRSG supporting structure includes ACC sheets, monitor-roofs of drum & burner operating level including drains to canal. Contractor has to install these roofs as per drawings. The cement required for jointing of the ACC materials will be issued by BHEL free of cost.

41.5 It shall be the responsibility of the contractor to provide prefabricated ladders **including materials at his cost** on columns for initial work till such time stairways are completed. No temporary welding on any structural member is permitted except under special circumstances with the approval of BHEL.

41.6 No members of the 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.

41.7 The contractor is strictly prohibited in using the HRSG / BOILER components like angles, channels, hand rails etc. for any temporary supporting or scaffolding works. In case of such misuse a sum as determined by BHEL Engineer will be recovered from contractor's bills.

41.8 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/ pipes within finally accepted rates.

41.9 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 within finally accepted rates.

41.10 Adjustments like removal of ovalities 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 carryout such work within the finally accepted price / rates as per instructions of BHEL, which shall include specified heat treatment & NDT procedures etc.

41.11 Certain adjustment in length may be necessary while erecting pipelines / ducts/ casings/ claddings etc. and the contractor should remove the extra lengths / add extra lengths to suit the final layout after preparing edges afresh by adopting specified welding/NDT/ heat treatment procedures, at no extra cost. 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.

41.12 The contractor shall completely erect & test all the integral piping systems, covered in the specification including sampling lines upto & including sample coolers, hangers & supports, valves & accessories in accordance with the drawings furnished. This includes all necessary bolting, welding, preheating, stress relieving, testing, cleaning & 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 shown on the drawings. All piping shall be erected true to lines & elevation as indicated in the drawings. All vents and drains for piping equipment covered in the scope whether shown in the drawings or not, shall be terminated at suitable sump-pit (unless otherwise directed) as directed by the engineer. The contractor shall assist BHEL in preparation of as built piping drawings.

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

41.14 Pipes sent in running lengths 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 up to 80 mm NB will have to be fabricated and tested at site within the finally accepted rates.

41.15 Economiser / super heater coils/ Reheater coils, burner panels & valves may have to be hydraulically tested individually, if required, before erection as instructed by BHEL engineer within finally accepted rates.

41.16 Fittings and welding of necessary instrumentation tapping points, thermocouples pads, valves, root valves, condensing vessels, flow nozzles orifice plate and control valves etc. will also be the responsibility of the contractor and will be done as per the instructions of BHEL Engineer within finally accepted rates. The erection, welding / NDT of all the above items will be contractor's responsibility even if the:

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

(ii) Items are supplied by any agency other than BHEL.

41.17 a) All the valves including motorised 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 / jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work within the finally accepted rates.

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

c) The contractor shall dismantle the valves & actuator for overhauling, servicing & lubrication wherever required as advised by the Engineer. The contractor shall also lap or grind valve seats for ensuring the 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.

41.18 No temporary supports should be welded on the pressure parts or piping. Welding of temporary supports / cleats etc., on main HRSG / BOILER columns should be avoided. Incase of absolute necessity prior approval from BHEL Engineer will be obtained by contractor.

41.19 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 and contractor shall be eligible for payment of such additional supports as per applicable item of rate schedule.

41.20 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 shut down.

41.21 Spring suspensions/ constant load hangers 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.

41.22 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.

41.23 All attachments welding including those for insulation works coming on pressure parts / non-pressure parts which the contractor has erected shall have to be done by the contractor within finally accepted rates only.

41.24 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 will 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. 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

41.25 Layout of small bore piping in HRSG / BOILER and fuel systems etc. 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 pipe lines even after completion of erection or from aesthetic point of view. Contractor at no extra cost to BHEL should carry this out. Bends up to 80 mm NB will have to be fabricated and tested at site within the finally accepted rates**.** As built drawings shall also be made by the contractor and submitted to BHEL after final execution of respective small bore piping work with in the final accepted tonnage rate.

41.26 Additional platforms and ladders of permanent nature for approaching different equipment, as per site requirement which may not be indicated in drawings shall be fabricated and installed by the contractor. However, the contractor will be paid for this work on accepted tonnage rate for erection irrespective of number of platforms. The materials required for platforms excluding consumables and T&P will be provided by BHEL, some materials for such work may have to be taken from packing materials, the

contractor will be required to retrieve the same from packing materials by using gas cutting etc. at no additional cost to BHEL.

41.27 Erection of power cylinders, motorised valves, valve actuators etc. coming under various groups is covered under the scope of this specification. However C&I calibration for pneumatic valves & power cylinders shall be arranged by BHEL through C&I agency at no cost to the contractor for this package. The alignment and any mechanical adjustments including link adjustment, opening & reconnection of links, replacement of valve / actuator or any mechanical part, air filter & regulator cleaning etc. required during calibration and operation, the same shall be carried by the contractor for this package. However, if re-calibration is required till handing over of the equipments the same shall be organised by the contractor for this package as detailed above with in the final accepted rates. The valves & electrical operated actuators covered under this package shall be erected, tested & commissioned by the vendor for this package.

41.28 Hanger rods are shown in the pressure parts arrangement drawings for HRSG / BOILER. Any cutting / welding of these hanger rods will be done by the contractor. The hangers for pressure parts will be tested for even distribution of load with the help of torque wrench, which is to be arranged by the contractor.

41.29 All rotating machines and equipment shall be cleaned, lubricated, checked for their smooth rotation, if necessary, by dismantling and re-fitting before erection. If, in the opinion of the BHEL engineer, the equipment is to be checked for clearances, tolerances at any stage of the work or during commissioning period, the contractor at his cost shall carry the dismantling, cleaning, lubricating and re-fitting. All rotating machines shall be rotated periodically during storage, erection and log maintained to avoid bowing of shafts.

41.30 All the shafts of rotating equipment should be properly aligned to those of the matching equipment to as perfect and as accurately as practicable. The equipment shall be free from excessive vibrations so as to avoid over heating of bearings or the conditions which may tend to shorten the life of equipment. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

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

41.32 Forced lub oil system of motors or rotating equipment form parts of the work under this specification.

41.33 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.

41.34 The contractor, at no extra cost to BHEL, shall carry out servicing and realignment of skid mounted equipment, if required by BHEL.

41.35 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.

41.36 Contractor shall carry out kerosene testing of all bearing housing of various rotating equipment like pumps, fans etc. as per BHEL engineer's instructions. Performance of

hydro test of oil coolers of rotating machines and other equipment as per BHEL engineer's instructions is included in the scope of work.

41.37 Certain rotating machinery after, initial runs and commissioning of the equipment, have to be hot aligned as per the instructions of BHEL engineer. Cleaning fans, ducting etc., free of extraneous steel, scaffolding materials, electrodes, all foreign materials etc. before trial run of rotating machinery, and at various stages of pre-commissioning activities as per BHEL engineer's instruction, is within the scope of work.

41.38 All the bearings, gear boxes, shaft and other rotating parts etc. of the equipment and electrical motors to be erected are provided with protective greases only. Contractor shall arrange as and when required by the engineer, for cleaning the bearing, gears etc. with kerosene or some other reagent, if necessary, by dismantling some of the parts of the equipment during erection and shall arrange for re-greasing / lubricating them with recommended lubricants and for assembling back the dismantled parts, within the finally accepted rates. Lubricants will, however, be supplied free of cost by BHEL.

41.39 After initial trial of rotating equipment, control and power cabling for motors and other equipment / instrumentation shall have to be disconnected for checking alignment and re-setting / re-alignment / hot alignment. Contractor shall have to arrange for disconnecting control and power cabling as per BHEL engineer's instructions and clearance and reconnect the control and power cabling after realignment. Quoted tonnage rate shall be inclusive of the above.

41.40 Packer plates should not only be blue matched with the foundations but also interpacker contact surfaces, contact surfaces between packer and equipment , contact surfaces between packer and foundation frame etc. shall also be blue matched by Prussian blue match checks and percentage contact shall be achieved by chipping, machining, scrapping as per BHEL engineer's instructions.

41.41 Contractor shall arrange changing of preservative oil in the gear boxes, journal and other bearing assemblies of rotating equipment when in storage areas or after erection of equipment as the case may be as per the instructions of BHEL engineer. Necessary lubricants / oil will be supplied by BHEL and the same will be drawn by contractor from BHEL / customer's stores and transporting to site. No additional payment will be made for such works even though supply of lub oil might have been made under regular despatchable unit no. against product group main assembly (PGMA) and appearing in the shipping list. Prior to the commissioning of the equipment, oil to be drained and collected in drums provided by BHEL and returned to BHEL /customer's stores.

41.42 The HT motor bearings shall be blue matched at site and checked for bearing clearances. The contractor shall carry out scraping of bearing housing if required. Check for air gap and adjustment of stator/ rotor for magnetic center of HT motor shall be carried out as part of erection.

41.43 The contractor shall be responsible for obtaining necessary approval and making whatever additions / modifications considered necessary by the Electrical Inspector, Boiler inspector or other authorities to bring the installation in conformity with the applicable rules and regulations. The liaison with the inspectors, arrangement for inspection / inspector's visit, preparation of documents, furnishing clarifications, information etc. as and when required will have to be done by the contractor with in the final agreed price.

41.44 Contractor shall take all safety measures and ensure that adequate precautions are enforced for area safety and good house keeping is maintained in their work area in line

with BHEL and it's client's safety policy. All packing material and scrap steel etc. shall be cleared from work site both inside 'plant courtyard' and area so allotted for site fabrication, on regular basis and transported to identified disposal yard as allocated by BHEL / it's client.

41.45 The temporary wiring used for construction power supply in fabrication area shall be taken through PVC pipes / conduit or overhead on temporary poles.

41.46 The entire work is being executed as per the specifications, drawing and documents furnished by BHEL manufacturing units and as directed by BHEL Engineers at site to the entire satisfaction of BHEL' client. BHEL's client / client's consultant has full authority to check / recheck / inspect any work, T&P, procedure, process etc. at any point of time jointly with BHEL or independently. It shall be responsibility of the contractor to cooperate in every respect and provide the necessary assistance with in the final accepted rates.

41.47 The fans and other rotating machines shall be checked for clearances & other vital tolerances. The IGV unit shall be serviced. Necessary assistance for balancing of equipment during trial run, if required, shall be provided by the contractor free of cost. .

42.0 WELDING, HEAT TREATMENT, RADIOGRAPHY and NDT:

42.1 The pressure parts & IBR pipe lines shall be erected in conformity with the provision of Indian Boiler Regulations and as may be directed as per any other standards/ 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. **Semi automatic welding (GMAW) process shall be used for non-pressure parts / ducting / structures etc to the maximum possible, considering its cost efficiency, better quality and time saving features.**

42.2 Welding of pressure parts / equipment / piping / high tensile structural steel shall be done by certified high pressure welders who possesses valid certificate of CIB of the state in which the equipment is erected as per provision of IBR. The HP. welder who possesses necessary certificate shall appear well in advance before the expiry of the validity of his certificate for re-qualification test 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 certificates have expired, shall have to be terminated forthwith.

42.3 All welders including tack welder , structural and high pressure welder shall be tested as per ASME section IX and approved by BHEL Engineer before they are actually engaged on work though they may possess the IBR certificate. BHEL reserves the right to reject any welder if the welder's performance is not found to be satisfactory. The records of qualification and performance of each HP welder shall be maintained by the contractor in Performa given by BHEL Engineer. All the welders qualified for the work will be issued an identity card by the contractor with the approval of BHEL Engineer and welder will keep the same with him at work place. The record of joints, consumables & equipments along with welders identity shall be maintained by the vendor as per BHEL Engineer's instructions.

42.4 The root run welding of all butt welds of tubes/ pipes (HP or LP), instrumentation tapping points etc. will be done by TIG welding process only. Subsequent welding will be done as per welding schedule / Instructions of the engineer including full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required. The contractor within

the finally accepted rates shall arrange purging with inert gas in case of stainless steel joints as per requirement.

42.5 Complete penetration of welding shall be achieved and all welded joints shall be subject to acceptance by the Engineer.

42.6 Engineer may stop any welder from the work if his work is unsatisfactory for any technical reason or if there is a high percentage of rejection of joints welded by a particular welder which, in the opinion of the Engineer, will adversely affect the quality of the welding though the welder has earlier passed the tests prescribed by Engineer. The welders having passed qualification tests does not relieve the contractor of contractual obligation to continuously check the welder's performance.

42.7 Faulty welds caused by the poor workmanship or lack of supervision of lack of supervision on the part of the contractor shall be cut and re-welded at the contractors expenses. The procedure for the repair of defective welds shall be approved by the Engineer prior to any repair being made. For each batch of approved brassed certified showing compliance with the specification shall be secured and shall be submitted to the BHEL Engineer.

42.8 All charges for testing of contractor's welders including destructive and non destructive tests conducted by BHEL at site or at any laboratory shall have to be borne by the contractor only. The materials for plate test pieces and for pipe and tube will be given by BHEL.

42.9 All welds shall be painted with anticorrosive paint, once Radiography and stress relieving works are over. Necessary consumables and scaffolding etc. including paints shall be provided by contractor at his own cost. Daily welding reports in the proforma suggested by BHEL should be submitted without fail.

42.10 **Only BHEL approved electrodes and filler wire will be arranged and used by the contractor, within the finally quoted price. BHEL reserves the right to test any 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 will have co-relation with the lot No. / batch No given on electrode packets. No electrodes will be allowed to be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven should also be calibrated and test certificate from Govt. approved / accredited test house traceable to National / International standards shall be submitted to BHEL before putting the oven in use. Periodical calibration for the same shall also be arranged by the contractor within the finally accepted rates.

42.11 The regulators used on welding machines shall be calibrated before putting these into use for work. Periodic calibration for the same shall also be arranged by the contractor at his cost and records shall be maintained. The regulators used with the gas cylinders should be of repute make and preferably ISI marked.

42.12 Preheating, radiography and other ND 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. All equipment's and consumables essential for carrying out the above process have to be arranged by the contractor at his cost.

42.13 Contractor shall arrange all necessary heating equipment with automatic recording devices. Also the contractor shall have to arrange for labour, heating elements, thermocouples, etc. insulating materials like asbestos cloth, ceramic beads, asbestos ropes etc. required fo rheat treatment/ stress relieve operations. Temperature shall be measured at least at two different points for pipes above 200 mm dia. by thermocouple, and recorded on a continuous printing type recorder. All the recorded graphs for heat treatment works shall be the property of BHEL. The contractor has to provide thermo-chalks, temperature recorders, thermocouple attachment units, graphs, sheets, etc. for checking within the finally accepted rates. 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 after setting up the weld joints for heat treatment operation prior to the starting.

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

42.15 Iridium-192 shall be used by contractor for radiography work. The geometric unsharpness shall not exceed 1.5 mm. Taking adequate safety precautions shall be the responsibility of the contractor while carrying out radiography. Necessary safe guards required for radiography (including personnel from BARC) shall be arranged by contractor at his cost. All related documents issued by BARC shall be submitted by the contractor to BHEL.

42.16 Low speed high contrast, 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.

42.17 All radiographs shall be free from mechanical, chemical or process marks, to the extent they should not confuse the radiographic image and defect finding. Penetra meter as per ASME, DIN, and ISO and as specified by BHEL must be used for each exposure.

42.18 Lead numbers and letters are to be used (generally 6 mm size) for identification of radiographs. Contract no., joint identification, source used, welder's identification and SFD are to be noted down on paper cover of radiograph.

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

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

42.21 For multiple exposure on pipes, an overlap of about 25 mm of film should be provided.

42.22 The contractor shall have a dark room fully equipped with radiography equipment, film (un-exposed), chemicals and any other dark room accessories ie all the facilities including airconditioners for storing and processing radiography films. There should be adequate number of radiography personnel with sufficient experience and certified by M/s BARC as Radiographer for conducting radiography test in accordance with safety rules laid down by Division of Radiological protection. These personnel should also be registered with DRP / BARC for film badge service. The proof of having sufficient film / chemicals to complete the entire work should be shown to BHEL.

42.23 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.

42.24 Contractor shall note that 100% radiography will be done at the initial stages on all the HP welding joints. Subsequently, radiographic inspection will be done on the basis of quality of welding. However minimum percentage of joints to be radiographed shall not be less than the requirement of IBR or as specified by BHEL. The percentage may be increased depending upon the quality of joints and at the discretion of BHEL. Every rejection shall be penalised with further two no of additional weld joints to be radiographed in case of percentage radiography.

42.25 If the contractor does not carryout 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.

42.26 All the radiographs shall be properly preserved and shall become the property of BHEL.

42.27 Since radio-isotopes are being used, all precautions and safety rules as prescribed by BHEL/BARC/Customer shall be strictly followed. BARC/ DRP Certificates to be provided before taking up the work.

42.28 The defects as pointed out by the engineer shall be rectified and re-radiographed immediately to the satisfaction of BHEL Engineer. The decision of the engineer regarding acceptance or otherwise of the joint will be final and binding on the contractor.

42.29 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 shall be replaced immediately.

42.30 Wherever radiographs are not accepted, on account of bad shot, joints shall be re-radiographed and re-shots submitted for evaluation. Radiographs shall be taken on joints after carrying out repairs. However, if the defect persists after first repair, as per radiograph, carrying out radiography shall be repeated till the joints is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radiographed at contractor's cost.

42.31 The contractor shall also be equipped for carrying out other NDT like LPI / MPI/ UT etc. as required as per welding schedule/ drawings within the finally accepted rates/ prices.

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

42.33 The contractor shall maintain a record in the form as prescribed by BHEL of all operations carried out on each weld and 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, heat treatment (if any) 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. All site welding joints shall be subject to acceptance by BHEL Engineer.

42.34 All butt / fillet welds shall be subject to dye penetration test as per the instructions of the Engineer at no additional cost.

42.35 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 will be allowed only wherever edge preparation otherwise is impractical. All slags / burrs shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of engineer.

42.36 The contractor's Engineer shall prepare as per direction of BHEL Engineer the 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 and submit the same to BHEL Engineer for approval. Such schedules shall be strictly adhered to by the contractor after approval.

43.0 APPLICATION OF INSULATION

The application of insulation materials & sheet casing work include but not limited to the following.

43.1 All attachment welding including welding of hooks / supports as per pitch both on equipment & piping shall have to be done by the contractor as per drawings or as directed by Engineer. Attachment welding shall have to be done by certified welders. If necessary contractor may have to cut the hooks without any extra cost. The HRSG / BOILER ducting / casings shall be internally insulated with ceramic wool and cladded with stainless steel sheet on stainless steel hooks & retainers.

43.2 Applying of red oxide paint including supply of paint on welded portions as directed by Engineer.

43.3 The mineral wool mattresses (bonded / unbonded) are received at site in standard sizes. These are to be dressed / cut to suit site requirements by the contractor.

43.4 The no. of layers / thickness of mineral / ceramic wool shall be as per various drawing / insulation schedule and as directed by Engineer. After applying the mineral / ceramic wool mattress, the required holding materials if necessary (by fabrication of rings/ hooks at no extra cost) shall be fixed as directed and as per drawings and specifications. Required material for fabrication of rings / hooks shall be supplied by BHEL free of cost.

43.5 Application of two coats of anti-corrosive black bituminous paint (corresponding to relevant IS code) on inner surfaces of sheet cladding and bitumen sealing compound on cladding joints, if necessary, is included in the scope of this work and will be carried out within the finally accepted rates. The sealing compound and the anti-corrosive black bituminous paint required for this work is to be arranged by the contractor at his cost

43.6 To ensure that the finished surface of the insulation conform to the dimensions and tolerances given in the drawing. Aesthetic finish and accuracy of work are most important.

43.7 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 tending to affect its quality by the provision of closed / semi closed sheds at his cost. If any damage occur to the material due to improper storage or due to any causes attributable to the contractor except for normal breakages or damages allowed in such cases, the cost of such damaged material shall be to the account of the contractor.

43.8 Contractor is liable for the accounting of the material issued to him and any unaccountable losses shall be made good by him.

43.9 All the 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.

43.10 Contractor shall mix & apply the refractory / insulation as per the instructions of BHEL Engineer. Castable refractory / insulation after application shall be cured as per the instructions of BHEL Engineer.

43.11 Application of Castable refractory between tubes, around burners, on ceiling is to be done as directed by Engineer and as per detailed drawings & specifications.

43.12 Dressing of insulation brick to suit site conditions, curing refractory concrete applied / sheet cladding over insulation form part of this work.

43.13 Contractor shall observe all precautions for laying / curing of Castable refractory. Any defective works found shall be rectified by contractor at his own cost including materials.

43.14 Making structural supporting work for pour able insulation, laying pour able insulation, adhering to all specifications and instructions during application form part of this work.

43.15 The contractor shall provide the required quantity of wire, nails, planks for formwork and other material for centering and grouting works.

43.16 The contractor shall leave certain gaps and opening 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 drawings at a later date by the contractor at his cost.

43.17 Plates, bars and rods and other materials shall be cut and rewelded from the fabricated pieces to suit erection requirements for which no extra payment shall be made to the contractor.

43.18 Aluminum / stainless steel sheet metal cladding over insulation will consists of plain / ribbed / corrugated sheets. The sheets will be supplied in standard sizes. Their application shall be carried out by fabrication to the sizes and shapes specified in drawings,beading, swaging, bewelling of sheets, crowning the sheets if necessary, application of two coats of anti-corrosive black bituminous paint on inner surfaces, fixing the same to supports over wool insulation with screws as specified in BHEL drawings or as instructed by BHEL Engineer.

43.19 A logbook shall be maintained by the contractor for the clearance of the area for application of insulation. If the contractor does the work on his own accord without prior permission the area shall be redone at his cost.

43.20 Wastage allowance for insulation materials issued are as follows:

a) Wool / LBM mattresses and cladding sheets : 2%
b) Castable refractory : 2%
c) Insulation bricks & mortar : 2%

43.21 If during erection and commissioning any of the parts are to be 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 and checking and for measurement of metal surface temperature the same may necessitate removal and reapplication of insulation and sheet metal cladding, which shall be done by the contractor at no extra cost and the erection rate quoted shall be inclusive of such contingencies.

43.22 Insulation of all expansion joints, dampers etc. shall be carried out after NDT / gas tightness test is completed.

43.23 Removable type of insulations to be provided for valves, fittings, expansion joints etc. as per the drawings or as directed by BHEL Engineer.

44.0 TESTING PRE-COMMISSIONING, COMMISSIONING AND POST-COMMISSIONING.

44.1 The contractor shall carry out the required test on the HRSG , ducts and pipelines such as gas / air leak test, hydraulic test etc. as instructed by BHEL using contractors own consumables, labour and scaffoldings. Air leak test on pressure parts preliminary to Hydraulic test by compressed air shall also be carried out to check and rectify the various leakage / defects etc.

44.2 The contractor shall carry out all the tests 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.

44.3 All the above tests should be repeated till all the equipment satisfy the requirement / obligation of BHEL and BOILER Inspectorate, if required at various stages. The contractor shall do the entire repair for site-welded joints arising out of the failures during testing as part of work within finally accepted rates.

44.4 All items / material required for conducting hydraulic test, alkali boil out, steam blowing etc., will be supplied by BHEL / its customer. However, servicing, dismantling and returning of the same to stores is the responsibility of the contractor who is erecting the equipment / piping. The contractor may note that **no separate payment shall be released for any temporary works** that are to be carried out for conducting pre-commissioning and commissioning tests. Bidders are advised to include expenses on temporary works along with the rates being quoted by them. Broadly the work on temporary systems will be divided as under:

All temporary piping along with insulation and supports for steam blowing; chemical cleaning and affluent disposal are to be carried out as part of Boiler contract. However Installation and operation of all equipment including tanks

and electrical switchgear along with their accessories shall be carried out by another agency. Contractor will be responsible for providing all help in the operation and any servicing required till completion of his commissioning activities.

Erection of blowers, blanks and putty required for conducting air tightness test and GD Test are to be installed. (Putty to be procured by the contractor).

The above is only a broad breakup of the temporary works. The engineer at site will make final break up. His decision will be final and binding by all the parties.

Dismantling of the temporary equipment and piping will be done by the agency that has erected the equipment. He will also return the equipment to the stores.

44.5 All items required for conducting hydraulic test, air/gas leak test, alkali boil out, chemical cleaning of pipe lines, steam blowing etc., will be supplied by BHEL/ its Customer. However, servicing, erection and dismantling and returning of the same to Stores is the responsibility of the contractor. The unit tonnage rate will cover all above activities.

44.6 It shall be the responsibility of the contractor to preserve the HRSG / BOILER as per BHEL's requirement.

44.7 Drum may be dispatched without fixing internals and internals may be sent separately in loose. The internals have to be fixed as and when required. Dismantling and re-assembly to be done to suit various commissioning requirements at no extra cost to BHEL

44.8 Commissioning of the HRSG will involve trial run of all the equipment erected, alkali flushing, alkali boil out, acid cleaning, passivation, preservation, steam blowing, floating of safety valves, flushing of all the lines by air, oil or steam as the case may be, trial run of the HRSG / BOILER, servicing of valves and any other works incidental to commissioning. Contractor shall provide various category of manpower in sufficient numbers along with supervisors / engineers including necessary consumables, IMTEs, T&P etc and any other assistance required during pre-commissioning, commissioning & post commissioning of equipment & attending any problem in the equipment erected by the contractor till handing over. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

44.9 The valves will have to be checked, cleaned or overhauled in full or in part before erection, after alkali boil out, steam blowing and during commissioning as may be necessary and is the part of erection & commissioning.

44.10 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 within the finally agreed tonnage rate 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.

44.11 During this period though the BHEL's customer's staff will also be associated in the work, the contractor's responsibility will be to arrange for the complete requirement of supervision, men, consumables, T&P and IMTEs till such time the commissioned units are taken over by the BHEL's customer.

44.12 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 contractor's finally accepted rates/ price shall be inclusive of all these factors also.

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

44.14 During commissioning, opening / closing of valves, changing of gaskets, realignment of rotating and other equipment, attending to leakage, minor adjustments of erected equipment may arise. The finally accepted price / rates shall include all such works.

44.15 All temporary supports shall be removed in such a way that pipe supports are not subjected to any sudden load. During hydro static 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.

44.16 The contractor shall carry out cleaning and servicing of valves and valve actuators prior to pre-commissioning tests and / or trial operations of the plant. System for recording of such servicing operations shall be developed and maintained in a manner acceptable to BHEL Engineer and 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 at no extra cost.

44.17 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.

45.0 DRUM / MODULE LIFTING

45.1 Boiler drum shall be unloaded either in storage area or near the erection site / boiler / HRSG depending upon site conditions, by another agency. Shifting / dragging of the same to erection site for erection shall be within the scope of this contract and will be erected as per site conditions and instructions of BHEL Engineer.

45.2 Boiler Drums of HRSG has to be lifted with 150 / 200/250 MT crane after the pressure part modules are positioned & secured. Being self-supporting the drum will not have any suspension arrangement. Fabrication & installation of the temporary structure for supporting & final alignment is in the scope of contractor. The structural material will be supplied by BHEL free of cost. Fabrication / erection and complete installation of drum lifting arrangements including consumables shall be carried out by the contractor at no extra cost. After completion of drum erection & alignment, the contractor shall dismantle the drum lifting arrangements.

45.3 For drum lifting, certain temporary bracings (to be supplied by BHEL) have to be erected to obtain proper rigidity of structure in place of permanent bracings. The same have to be removed and replaced with permanent bracing. No payment will be paid for erection, dismantling and returning of temporary bracings.

45.4 HSFG Bolts are to be tightened by calibrated torque wrench as per the instructions of the Engineer. These should be check tightened / re-tightened by torque wrenches before drum lifting as instructed by the Engineer.

45.5 The pressure part (modules) are received at site with temporary transportation arrangement. The contractor has to remove these structure at defined stages of material handling / erection at no extra cost to BHEL. The temporary structures has to be accounted / returned to BHEL stores within the quoted rates.

45.6 Structural steel will be provided for handling of single module of HRSG and for up-righting them. Fabrication of this structure will be in the scope of the contractor. After erection of the modules this structure has to be accounted for / returned to BHEL stores. The contractor will be paid as per the quoted tonnage rate.

46.0 PROGRESS REPORTING

46.1 Contractor is required to draw mutually agreed monthly erection program in consultation with BHEL Engineer well in advance. Contractor shall ensure achievement of agreed programme and shall also timely arrange additional resources considered necessary at no extra cost to BHEL

46.2 Weekly progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled programme shall be discussed for actions to be taken for achieving targets. Contractor for discussions shall also present the programme for subsequent week. The contractor shall constantly update/ revise his work programme to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of non-conformities.

46.3 The contractor shall submit daily, weekly and monthly progress reports, HP joints welding and radiography reports, manpower reports, materials reports, consumables report and other reports as per proforma considered necessary by the Engineer.

46.4 The progress report shall indicate the progress achieved against planned, with reasons indicating delays, if any, and shall give the remedial actions which the contractor intends to take to make good the slippage or lost time, so that further works again proceed as per the original programme and the slippages do not accumulate and effect the overall programme.

46.5 The daily manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

47.0 DRAWING AND DOCUMENTS

47.1 The detailed drawings, specifications available with BHEL engineers will form part of this tender specification. These documents will be made available to the contractor during execution of work at site. The contractor will also ensure availability of all drawings / documents at work place.

47.2 Necessary drawings / documents to carry out the erection work will be furnished to the contractor by BHEL on loan which shall be returned to BHEL Engineer at site after completion of work. Contractor shall ensure safe storage and quick retrieval of these documents.

47.3 The contractor shall maintain a record of all drawings and documents available with him in a register as per format given by BHEL Engineer. Contractor shall ensure use of

pertinent drawing/ data/ documents and removal of obsolete ones from work place and returning to BHEL.

47.4 The data furnished in various annexures enclosed with this tender specification are only approximate and for guidance. However, the change in the design and in the quantity may occur as is usual in any such large scale of work.

47.5 Should any error or ambiguity be discovered in the specification or information the contractor shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor.

47.6 Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimension / details, without specific approval of BHEL.

47.7 Any ambiguity found in the drawings should be brought to the notice of engineer prior to start of work.

47.8 Certain revisions of drawings are received during the course of execution, if the same have been received prior to start of particular (specific) job then no claim will be admissible on this account.

48.0 EXTRA WORK:

48.1 BHEL may consider for payment of extra works on man-hour basis @ Rs.30/- (Rupees thirty only) per man-hour only for such of those works which:

a) Require major revamping or repair on the BHEL / CUSTOMER supplied material and which are totally unusual to normal erection work.

b) Require rectification / modification for change or improvement in the design during erection or commissioning,

c) Requiring fresh fabrication of components in place of rejected /replaced components. Where rejection is not due to contractor's workman-ship.

48.2 The rates indicated as above, shall include over time, if any, consumables, supervision, use of tools and tackles and other site expenses and incidentals.

48.3 The extra works, if any, shall be carried out by a separate gang, which can be identified for certification of man-hours. Logbook should be maintained and should be signed jointly by the contractor's representative and the BHEL Engineer on day-to-day basis. However, signing of the logbook does not necessarily mean acceptance of the extra works, which would be identified by Engineer whether work is covered in one of the above categories. Only those works and man-hours, which are certified by the BHEL Engineer-in-charge, will be considered for payment. The decision of BHEL in this regard shall be final and binding on the contractor.

49.0 INCOME TAX AND SALES TAX

49.1 **TDS under Income Tax, Sales Tax, VAT etc,** if any, shall be deducted at prevailing rates on gross invoice value from the running bills unless Exemption Certificate from appropriate Authority / Authorities is furnished.

49.2 **Price quoted shall be inclusive of all taxes except service tax.** The service tax, as legally leviable & payable by the contractor under the provisions of applicable law/act, shall be paid by BHEL as per contractor's bill. However, contractor shall have to submit proof of service tax deposited by them immediately after the deposit but not later than the next bill submitted after the due date of deposit. The contractor shall furnish proof of Service Tax registration with Central Excise Division covering the services covered under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by contractor on BHEL for this project. The contractor shall obtain prior approval of BHEL before billing the service tax amount and should submit proper CENVATABLE invoice as per Service Tax Rules.

With introduction of Cenvat credit rules 2004 which came into force w.e.f. 10.09.2004, excise duty paid on input goods including capital goods used for providing the output service and service tax paid on input service can be taken credit of against the service tax payable on output service. As such, while offering the rates, the contractors may take into account the benefit of above provisions as the cost of input to contractors will be the cost net of excise duty and service tax and adjust their offer price accordingly to make it more competitive

49.3 In VAT applicable States, "Tax Invoice" if required under the relevant State VAT law shall be submitted alongwith other compliances as per concerned VAT Act.

49.4 Contractor shall get his organization registered with concerned sales tax/VAT authorities within 15 days of award of this contract, if applicable. The delay on this account and delay in bringing the material shall be to contractor's account and no extension of time shall be allowed on this account. The sales tax/VAT registration for this contractor shall be forwarded to BHEL within 30 days from the date of LOI. In case the contractor is already registered for sales tax/VAT with Govt. Authorities he must quote his registration no, while submitting their tender

49.5 Contractor has to make his own arrangement at his cost for completing the formalities, if required, with Sales Tax/VAT Authorities, for bringing their materials, plants, and equipment at site for the execution of the work, including arrangement of Road permit as applicable under this contract.

50.0 PRICE VARIATION

50.1 The finally accepted rates for scope of work as defined in this tender are subjected to price variation provisions as per following formula. The required documents shall be submitted by contractor.

$$P1 = \frac{0.75 \times P0 \,(F1 - F0)}{F0}$$

P1 = Increase / decrease in billing amount (variation) for the particular month of billing.

P0 = Grossed billed amount for the month as per contract provisions.

F1 = All India CPI published by Labour bureau, Simla, Govt. of India, for Industrial workers (Base 2001 =100) applicable for the month under consideration i.e. for which bill has been raised.

F0 = All India CPI published by Labour bureau, Simla, Govt. of India, for Industrial workers (Base 2001 =100) applicable for the month of opening of technical bid.

50.2 Price variation as per above formula will be calculated and paid on the total contract value (excluding payments towards extra works and over run , if any) on month to month basis from the date of award. BHEL however reserves the right to freeze variation for that much of duration of delays, from time to time, which are entirely attributable to the contractor.

50.3 With the provision of price variation as above **NO CLAIM / COMPENSATION** on account of any increase whatsoever, (irrespective of whether variation are steep / unanticipated or not compensated by the above escalation provisions in full towards minimum wages, consumables, electrodes, gases or any other item / reason) will be payable during the entire period of execution including extended period, if any.

50.4 Price variation on last 5% of CV will be based on average index.

51.0 RATE SCHEDULE

51.1 Contractor shall fully understand equipment description and scope of work before quoting. The scope of work and responsibility of the contractor as mentioned under these specifications shall be covered within the quoted rates.

51.2 The tenderer shall quote the rates as per the rate schedule only, in part II price bid (Original). Conditional price bids or price bids with any deviation / clarification etc. are liable to be rejected. No cutting / erasing / over writing shall be done.

52.0 INSTRUCTIONS TO TENDERER

52.1 Offers received without data / information required to be submitted under tender clauses-11.1 to 11.11 are liable to be rejected. All these data / information should be duly supported by documentary evidences (Refer note below clause-11)

52.2 No deviations to the tender conditions will normally be accepted.

52.3 The tenderer are advised to physically visit the site and fully acquaint themselves with site conditions, transportation routes, various distances and the fact that other contractors would be working in this area their structures are to be protected. The material brought and stacked for construction should not make hindrance to other contractors. Necessary precaution and arrangements including sprinkling of water during work as acceptable to BHEL for safety & security for the above have to be made by the contractor. No claim whatsoever will be entertained by BHEL on any such account and the contractor's rates shall be deemed to have taken this into accoun.

52.4 The contractor in the event of this work awarded to him, shall establish a site office at site and keep posted an authorised responsible officer who should hold a valid power of attorney for the purpose of the contract. Any order or instruction of the Engineer or his duly authorised representative shall be communicated to the contractor's representative at site office and the same will be deemed to have been communicated to the contractor at his legal address.

52.5 **LIQUIDATED DAMAGES (LD)-** For delay in completion of work attributable to the contractor, the LD shall be applicable at the rate of ½% of the contract value per week of delay or part thereof limited to a ceiling of 10% of the contract value as mentioned under clause no.25.5 of the GCC of the tender

52.6 SECURITY DEPOSIT-- The contractor shall submit Security Deposit within 15 days from the date of issue of LOI as per clause no. 16.2 of the General Conditions of Contract (GCC). In case the contractor opts to furnish Bank Guarantee as a part of Security Deposit, the BG shall be issued as per the Performa enclosed as per Annexure- H of the GCC and also that the BG should be issued preferably through any of the Member Banks as listed in GCC;

For BG through any other Nationalized Bank (Not covered in the list of Member Banks of GCC), the discretion of its acceptance shall lie solely with BHEL.

52.7 INSURANCE

52.7.1 Besides provisions under clause no. 29.0 of GCC regarding insurance, the following shall also be applicable. The contractor shall also take care of the same while submitting their offer.

52.7.2 Insurance for all materials pertaining to the Contractor (T&Ps, Construction Materials etc.) during transit, storage and during construction shall be in his (Contractor's) scope.

52.7.3 The Contractor shall provide insurance cover to all persons employed/engaged by him throughout the period of Contract, including the extended period, if any.

52.7.4 In addition to insurance as per Workmen's Compensation Act, Employer's liability and also Group Personnel Insurance for employees are also to be taken by contractor.

52.8 OTHERS

52.8.1 In case of any contradiction between General Conditions of Contract (GCC) and Special Conditions of Contract (SCC), the latter shall prevail.

52.8.2 The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of pre-qualification evaluation / Techno-commercial bids and acceptance of customer. BHEL reserves the right to reject the bidders with unsatisfactory past performance in the execution of a contract. BHEL's decision in this regard shall be final & binding.

SECTION - III B

SPECIAL CONDITIONS OF CONTRACT

Cl. No Description

SPECIAL CONDITIONS OF CONTRACT

53.0 SCOPE OF WORK

53.1 Scope of these specifications include but not limited to following:

(a) Taking delivery of material from project stores/ storage yards / storage place, shifting to erection site, their preservation, safe keeping, watch & ward, checking, dressing, chipping, and leveling of foundations, pre-assembly, erection, alignment, welding, radiography and other nondestructive testing wherever needed, heat treatment, finish painting including supply of paints etc., hydraulic testing, air leak test, chemical cleaning, alkali boil out, steam blowing and safety valve floating including erection & dismantling of all temporary piping, valves, pumps, tanks etc. required for above operations and other commissioning activities including post commissioning, Unit trial operation and handing over of 4 x 272 TPH HRSG (including 70 M high steel chimney) along with related auxiliaries & piping at 1500 MW (N) Pragati-III CCPP of Pragati Power Corporation Bawana at Bawana, Delhi.

(b) **The PG wise break up of HRSG and piping is tentatively as indicated under Annexure-I (A) & I(B). Approx. weight to be erected shall be 21720 MT for HRSG & 1828 MT of piping systems under as indicated in Annexure-I(A) & I(B).** But the contractor is required to erect actual tonnage (irrespective of any variation plus or minus) which may be necessary to commission above HRSG / Boilers and complete the work in all respects as detailed in tender specifications, for which payments shall be released on finally accepted tonnage rates.

The total weight of chimney (for each HRSG) is approx. 490 MT and its shells will be supplied tentatively of 6.5 M dia & 2.5 M height. Each shell shall be supplied in two halves & same has to be erected / welded at site after removing ovality. The chimney is to be insulated on outside with mineral wool & aluminum cladding upto full length. The scope of work also includes erection & commissioning of earthing, aviation & lightening arrestor of chimney as supplied by BHEL. No Claim will be entertained, in case the number of shell increases due to change in shall height.

53.2 The weights and other details indicated under various Annexures are tentative and may vary. The contract value will be worked out based on the rates quoted against each item of rate schedule and quantity indicated against those items. The quantities indicated against each item may vary to any extent and No compensation will be payable in variation of Individual quantity. **However in case of over all variation in Contract value (as indicted in LOI), beyond (minus) 30%, the contractor will be eligible for compensation as per the following provision:**

"The total executed value shall be raised by 10 % subject to the condition that the total value of work executed plus increase as above shall be limited to 70 % of the awarded contract value"

53.3 **The contractor under this contract shall also provide free of cost services of skilled persons for a total period of 96 Man-months exclusively for use by BHEL. This manpower will be required for following services**

- Qualified persons for maintaining store record and posting stock ledgers and secretarial work. (24 manmonths)
- Skilled workers for working in store, office and colony. (36 manmonths)
- Unskilled workers for working in store, office and colony. (36 manmonths)

Persons so deployed shall have to work in extended hours whenever required. Workmen provided as per the above provisions shall be fully trained and experienced in the nature of work for which they are deployed.

In case these services are not utilized for any reason whatsoever, fully or partly, recovery at the rate of the prevailing minimum wages at Bawana, Delhi for the categories given plus 10 % will be made from the final bill of the contractor.

53.4 **The Customer Pragati Power Corporation Limited (PPCL) and / or their Consultant (NTPC) 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 at no extra cost to 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**.

53.5 Contractor shall make necessary arrangements to ensure following :

- **Contractor shall ensure deployment of Qualified level-2 Engineer for NDT services at site.**
- Contractor shall ensure **deployment of Qualified & Experienced Safety Engineer / Officer** at site.
- It is the responsibility of the contractor to engage his workmen in shifts or on overtime basis for achieving the targets set by BHEL. **Deployment of adequate resources (including necessary illumination facilities) for minimum two shift operation (so as to work in all the areas simultaneously) has to ensured by the contractor**. The contractor's finally accepted rates shall include all these contingencies.
- Contractor shall ensure that all the **T & Ps deployed** by them, including cranes, (Indicative lists of T&Ps and IMTEs to be arranged by the contractor **are given as per Annexure-III & IV**) **are regularly certified by approved testing agency** & the relevant certificates to this effect are to be given to BHEL for records**.**

It may be noted that non-compliance to the above three conditions will result in penal action as may be decided by the competent authority of BHEL.

53.6 BHEL Civil contractor is carrying out barricading of entire working area. However localized barricading may be required to carry out works like welding, gas cutting, grinding etc. Localised barricading of construction area, using GI sheet, scaffolding etc. is to be arranged by the contractor for subject work at his cost. Contractor may have to take required work permit, as per existing refinery procedures for carrying out works which may produce sufficient heat to ignite flammable vapor.

53.7 **The detailed NTPC specifications related to power cycle piping, low pressure piping, painting & Erection conditions of contract for work to be executed under this specification are enclosed with this tender document alongwith The General arrangement drawings of HRSG & Steel Chimney. (Annexure-V)**

53.8 **For Piping Systems, P91 materials is envisaged for main steam & HRH piping . 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 and their staff are advised to get familiarized/trained with th1s work process/procedure. In addition to the general clauses for Welding, HT and NDT given under clause 42 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.**

The details mentioned hereunder comprise of the major requirements for the process. The Contractor has to provide all services and consumables required for completion of the work.

Erection, welding, heat treatment and NDE works or as specified by the BHEL during execution of **PIPING OF P91 MATERIAL** and for the combination of materials like P-22 with P-91, or other combinations of alloy steels shall be the part of contract. Some of the salient details in regards to 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.

53.8.1 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.

53.8.2 Cutting of P-91 material shall be done by bandsaw / hacksaw /machining / grinding only.

53.8.3 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.

53.8.4 During edge preparation care should be taken to avoid excessive pressure to prevent heating up of the pipe edges.

53.8.5 All edge preparation done at site shall be checked by Liquid Penetration Test. **Weld built-up on edge preparation is prohibited.**

53.8.6 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.

53.8.7 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 U. T on weld joint.

53.8.8 Provide Enclosure for Welding area suitable for guarding against cold draught, water and dust at all welding locations.

53.8.9 No pre-heating is required for **fixing Thermocouples** (of Ni-Cr / Ni – Al of 0.5 mm

gauge size) **with resistance spot welding**.

53.8.10 Argon gas to be used both for purging as well as shielding shall be of 99.99 purity levels conforming to IS 53.860-1998. 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

53.8.11 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.

53.8.12 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.

53.8.13 NA

53.8.14 Purging is not required in case of nozzle and attachment welds, when they are not full penetration joints.

53.8.15 Start purging from inside of pipe when root temperature reaches 220 deg. Centigrade. Provide continuous and adequate Argon gas to ensure complete purging in the root area. The minimum preflushing time for purging before start of welding shall be 5 minutes, irrespective of the pipe size.

53.8.16 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 deg. Centigrade 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.

53.8.17 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.

53.8.18 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 P-91 with P- 91 material shall be 760 + 10 Deg. 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.

53.8.19 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

53.8.20 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.

53.8.21 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.

53.8.22 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.

53.8.23 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.

53.8.24 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.

53.8.25 Welders qualified as per ASME Section – IX and IBR on P-91 material shall only be engaged for the welding of 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.

53.8.26 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.

53.8.27 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, if required in addition to 1 no being provided by BHEL, 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.

53.8.28 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.

53.8.29 All the consumables to carry out the work for the P91 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 deg C, glass fiber cord dia 3 mm (twisted) temp rating 1260 deg C, ceramic fiber blanket RT grade density 96 kg / cub M-

temp rating 1260 deg C, ceramic fiber rope fiber glass 12 mm dia.- temp rating 1260 deg 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.

53.8.30 1 no. 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 excegencies of power failure for heating processes of P91 materials on account of power failures. Cables and switches, required fuels, operator and other consumables & its operations and maintenance shall be in the scope of contractor within the awarded value.

53.8.31 The contractor shall arrange welding Machine for Demagnetizing material along with cable and Residual Field Indicator.

53.8.32 DO'S AND DON'T'S DURING P-91 WELDING, HEAT TREATMENT AND NDE AT CONSTRUCTION SITE.

DO'S :

- Cutting by Band saw / Hack saw / Machining / Plasma cutting.
- Pipe edge preparation by machining. Machining shall be done without excessive pressure to prevent heating up of pipe.
- Grinding may be done on exceptional cases taking adequate care to prevent overheating.
- Thermocouple wire (hot / cold junctions) shall be welded with condenser discharge portable spot-welding equipment.
- Reserve thermocouples shall be made available, in case of failure of connected thermocouple elements.
- Ensure adequate Argon gas for complete purging of air inside the pipe before starting GTAW root welding.
- Ensure preheating at 220 deg. C minimum before GTAW root welding.
- Start preheating only after clearance from welding engineer / Quality assurance engineer for weld fit-up and alignment of the joint as well as fixing of Thermocouples (for Induction heating).
- Do visual inspection on root weld maintaining weld preheat temperature.
- Continue Argon purging until the GTAW root welding followed by minimum two filler passes of SMAW is complete.
- Perform partial root welding to facilitate fit-up, if necessary.
- Ensure that only one layer of root welding using TGS 2CM filler wire is deposited wherever necessary.
- Ensure proper use of TIG wires as identified by colour coding or suitable hard punching.
- Keep the GTAW wires in absolutely clean condition and free from oil , rust etc.
- Dry the SMAW electrodes before use.
- Ensure inter-pass temperature is less that 350 deg. C.
- Hold at 80-100 deg. C for a period of minimum 1 Hr. before start of PWHT.
- Record entire heating cycle on chart through recorders.
- Exercise control during grinding of weld and adjoining base metal while removing surface surface / sub-surface defects or during preparation of NDE.
- Ensure no contact with moisture during preheat, welding , post heat and PWHT of weld joints.
- Ensure removal of Argon purging arrangements after welding.

- Use short Arc only. The maximum weaving shall be limited to 1.5 times the dia of the electrode.
- Obtain WPS from equipment / piping supplier (combination welding) for welding of Pipe with equipment.

DON'T'S

- Avoid Oxy-Acetylene flame cutting.
- Avoid weld-build up to correct the weld end or to set right the lip of the weld bevel.
- Avoid Arc strike on materials at the time of weld fit-up during welding.
- Do not tack weld the thermocouple wires with manual ARC / TIG welding.
- No GTAW root welding without thorough purging of root area.
- Do not use Oxy-Acetylene flame heating for any heating requirement.
- Do not use thermal chalks on the weld groove.
- Do not stop Argon purging till completion of GTAW root welding and two layers of SMAW.
- No tack welding or Bridge piece welding is permitted.
- Do not use unidentified TIG wires or electrodes.
- Do not exceed the maximum inter-pass temperature indicated in WPS.
- Do not allow moisture, rain, water, cold wind, cold draft etc. to come
- in contact with the weld zone during the entire cycle from preheat to
- PWHT.
- Do not exceed the limits of PWHT soaking temperature.
- Do not interrupt the welding / heating cycle except for unavoidable power failures.
- Do not use uncalibrated equipment for temperature measurement during heating, welding, post-weld heat treatment etc.

54.0 FINISH PAINTING

54.1 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. Mostly the equipment / components installed are with one coat each of primer paint and synthetic enamel / heat resistant paint. However, due to storage and handling, the same may have got deteriorated or 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. These cleaned surfaces are to be touch up painted with suitable approved primer matching with shop paint approved final colour. Bare surfaces / unpainted surfaces shall be provided with two coats of suitable primer after cleaning as above. **The detailed NTPC specifications related to painting for work to be executed under this specification are enclosed with this tender document.**

54.2 After applying primer as above, all the structure, equipment / items and piping (covered under the scope of this contract) are to be finished painted with approved quality synthetic enamel paints (as specified by BHEL engineer) to achieve proper finish and film thickness as per drawings / specifications. The minimum thickness of painting as specified has to be checked by Alchometer (to be arranged by contractor) duly calibrated / suitable means as per advice of BHEL Engineer. Chimney is required to be painted out side in full

length using heat resistant and acid resistant aluminum paint silencers and un-insulated steam lines have to be painted with Heat Resistant Aluminum paint

54.3 Certain equipment like control panels, valves etc. shall require spray painting. The contractor shall make arrangements of the required equipment for spray painting of such equipment at his own cost. Spray painting at the job site shall be permitted only at times and locations approved by the owner / Engineer.

54.4 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 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. 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 the finally accepted rates. 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. No paint whose shelf life has expired should be used for painting. The contractor shall ensure availability of

- Ford Cup-4 to measure consistency of paint,
- Automatic magnetic gauge to measure the dry film thickness and
- SSPC Visual standards to assess degree of cleanliness of surfaces to be painted.

54.5 The contractor shall provide legends with direction of flow / colour banding on equipment and piping in size specified by Engineer. Letter writing shall be done in Hindi / English or in both languages.

54.6 The painters have to under go test and only qualified painters will be allowed to work. The contractor shall make all arrangements including materials for testing of painters at his cost

55.0 FACILITIES TO BE PROVIDED BY BHEL / CONTRACTOR

55.1 BHEL shall provide rent free limited open space, for office & storage shed, as and where made available by PPCL. It is the responsibility of the contractor to construct sheds, provide all utilities and dismantle and clear the site after completion of work or as and when required , as a part of his scope of work.

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

55.3 Construction power, for construction purposes as well as office use will be provided ON CHARGABLE BASIS (@ prevailing NDPL rates) at one point near erection / construction site from supply point. Required energy meter, duly calibrated, for measurement of power consumed has to be arranged / installed by Contractor at his cost. Further distribution of power shall be done by contractor at his cost. All wiring must comply with local regulations and will be subject to BHEL's inspection and approval before connecting supply. Contractor is also required to make backup arrangement (providing DG set etc) for power supply to ensure smooth progress of work even during non-availability of construction power.

55.4 Provision of distribution lines of power from the central points to the required place with proper distribution boards observing the safety rules laid down by the 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 shift / hours accordingly and deploy additional manpower if necessary so as to achieve the targets.

55.5 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.

55.6 Adequate lighting facilities such as flood lamps, hand lamps and area lighting shall be arranged by the contractor at the site of construction, contractor's material storage area etc. within finally accepted rates.

55.7 No claim for damages will be entertained by the Company on account of interruptions of water supply or limitation of quantity of water as aforesaid or on account of the water so taken being not fit for construction purposes or on any other account in connection with such water supply.

55.8 **BHEL will make available water for construction/ testing purposes close to the construction areas free of charge at a single point in site. Any further distribution shall be the responsibility of the contractor. Potable / drinking water shall also be provided free of charge at a single point in site & further distribution shall be the responsibility of the contractor.**

55.9 The Contractor should make arrangements for storage of sufficient quantity of water required for work.

55.10 The Contractor shall during the progress of the work, provide, erect and maintain at his own expenses all necessary temporary workshops, stores, consumables, offices, etc. required for the proper and efficient execution of the work. The planning, setting and erection of these buildings shall have the approval of the Engineer and the Contractor shall at all times keep them tidy and in a clean and sanitary condition to the entire satisfaction of the Engineer.

55.11 On completion of work or as and when required by BHEL, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, same will be got done by the Engineer and expanses incurred shall be recovered from the contractor along with prevailing overhead. The decision of BHEL Engineer in this regard shall be final.

56.0 TIME SCHEDULE

56.1 The contractor is required to commence the work within 15 days from the date of issue of letter of intent unless BHEL decides to fix any other later date. **However, the actual date of start of work, for the purpose of establishing zero date of the contract, will be certified by BHEL Engineer after adequate mobilisation of manpower and T&P by the contractor for material handling work and site facilities**.

56.2 Entire work as detailed in tender specification **shall be completed within 21 months from the scheduled date of start of work** as per the programs / milestones indicated by BHEL. Contractor has to mobilise adequate resources to meet BHEL's commitments to their customer as indicated from time to time. **In case due to reasons not attributable to the contractor, the work gets delayed and additional manpower**

/ resources have to be mobilized so as to expedite the work to meet various milestones, same shall be done within the quoted rates as per Rate Schedule, at no extra cost to BHEL. In the event the contractor fails to respond to these requirements, BHEL shall take appropriate actions to meet customer's commitments in line with the provisions of General Conditions of Contract.

56.3 The various mile stone dates to be achieved, for combined cycle Module-1 (consisting of GT/ HRSG #1, #2 & STG #1), as per the current status of contract are as below:

MILE STONES	MONTH
HRSG #1 :	
Start of HRSG #1 Erection	**15 Days from LOI**
Drum (HP, IP & LP) erection	**6th month from start of erection**
HRSG Hydraulic Test	**6th month from start of erection**
Gas in & ABO	**11th month from start of erection**
Alkali Boil out	**12th month from start of erection**
HRSG #2 :	
Start of HRSG #2 Erection	**3rd month from start of erection**
Drum (HP, IP & LP) erection	**8th month from start of erection**
HRSG Hydraulic Test	**10th month from start of erection**
Gas in & ABO	**13th month from start of erection**
Alkali Boil out	**14th month from start of erection**
Steam blowing & SVF (Module-1)	**15th month from start of erection**
Trial operation (Module-1)	**17th month from start of erection**

The milestones of HRSG # 3 & 4 shall follow with a time lag of two months respectively. Milestones of combined cycle Module-2 (consisting of GT/ HRSG #3, #4 & STG #2) shall follow with a time lag of four months from module-1.

56.4 The work under the scope of this contract is deemed to be completed in all respects, only when all the works are carried out and the testing and trial runs including safety valve floating, and clearance from Statutory Authorities are completed. The decision of BHEL on completion date shall be final and binding on the contractor.

57.0 OVER RUN

57.1 In case due to reasons not attributable to the contractor, the work gets delayed and scheduled completion gets extended, the contractor shall not be entitled for any over run compensation for a period of first 3 (THREE) months after the contractual completion date. In case the scheduled completion time gets extended beyond 3 (THREE) months as stated above, the contractor shall be considered for payment of fixed over run charges @ Rs 80,000/- PM (Rupees Eighty thousand only) per month on receipt of advance notice intending to claim over run and on fulfillment of following conditions:-

a) The reasons for delay in completion of work are not attributable to contractor but however subject to the provisions of clause - 31.

b) The targets fixed during the over run period are achieved by contractor.

57.2 Once the claim of over run charges is admitted no other compensation whatsoever (like for delays in receipt of materials, availability of fronts etc.) will be entertained.

57.3 The contractor shall maintain sufficient workforce and other resources required for completion of the job expeditiously / regular up keep, operation, maintenance , lubrication of erected equipment till the actual commissioning of the unit for the entire contractual period including total extended period.

57.4 For the purpose of ORC the actual date of start of erection as certified under clause 56.1 will be considered.

58.0 TERMS OF PAYMENT

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

58.2 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.

58.3 Subject to any deduction which BHEL may be authorised to make under the contract, the contractor on the certificate of the Engineer at site be entitled for payment as explained hereunder on prorata basis:

(I) ADVANCE PAYMENT

(a) 5% of the contract value shall be paid as interest bearing advance against submission of a Bank Guarantee for an amount equal to 1.25 times of advance valid for 24 months initially and thereafter extension for a period upto which the advance is fully adjusted. The interest chargeable shall be Prime Lending Rate of State Bank of India plus 2%.

(b) The advance paid shall be recovered from the contractor's progressive bills to an extent of **10%** of each progressive bill amount till it is fully recovered. The BG amount shall be allowed to be reduced every six months by an amount equal to the amount adjusted against running bills.

(c) The BG shall be returned after full adjustment of the entire amount of advance along with interest

(II) PROGRESSIVE PAYMENT ON PRO-RATA BASIS

A1 83 % OF TONNAGE RATE ON PRORATA BASIS AS FOLLOWS

a. **15%** of the Contract rate on pro-rata basis on completion of pre-assembly wherever applicable and **15%** of the contract rate on placement in position and rough alignment for the items where pre-assembly is involved.

OR

30% of the Contract rate on placement in position and rough alignment for the items where pre-assembly is not involved.

b. **53%** of the Contract rate on pro-rata basis on completion of final alignment / fastening / welding / grouting along with proper supports including radiography / NDT/ Stress relieving wherever involved.

A2 MILESTONE PAYMENTS (10 %)

- 2% of CV on fixing of base plates and start of column erection of the HRSG (4 x 0.5 %)
- 2% of CV on completion of hydro test of the HRSG. (4 x 0.5 %)
- 2% of CV on completion of ABO of the HRSG. (4 x 0.5 %)
- 2% of CV on completion of steam blowing and SV Floating. (4 x 0.5 %)
- 2 % of CV on completion of trial operation of HRSG (4 x 0.5 %)

Notes:

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 upto 50% of milestone payment on completion of work, to the extent possible, required for carrying out that particular milestone / commissioning activities.

A3 FINAL PAINTING (2 % of CV)

2% (4 x 0.5 %) of CV on successful completion of final finish painting including supply of paint (BHEL Site in charge at his discretion may split above and release payment on prorata basis for supply as well as for application of paints)

(III) **2.5% of CV** shall be payable on handing over of the unit to BHEL's customer or 3 months after the contractor has discharged his responsibilities as stipulated in this contract whichever is earlier, if delay in handing over is not attributable to contractor. The unit shall be deemed to be handed over on completion of trial operation.

(IV) The balance contract value will be payable on completion of all pending work, rework wherever required, reconciliation of materials, clearance of site and labour colony area in all respect and on submission and passing of final bill.

NOTE: 1. Above payment against item No. III & IV shall be released after adjustment of the contract value based on actual work carried out against respective item of rate schedule.

2. The entire terms of payment indicated above is tentative. Further break up / re-distribution of terms of payment against any of the above TOP will be carried out at site to suit site requirement and entirely at the discretion of site in charge.

WEIGHT SCHEDULE
(HRSG AND CHIMNEY)

SUMMARY OF WEIGHTS

Approximate weight to be erected (FOR 1 HRSGs): 5430 MT

Total approximate weight to be erected for Four No. HRSGs: 21,720 MT

AA) Product Group (PG) Wise Weight Schedule For Each HRSG

Sl.No	PGMA	Description	Wt.in Kgs	Remarks
1	04-116	BOILER DRUM-IP	38036	
2	04-118	BOILER DRUM-HP	156493	
3	04-144	DRUM SLIDE BEARING	130	
4	04-146	DRUM SLIDE BEARING	130	
5	04-148	DRUM SLIDE BEARING	130	
6	04-149	FASTENERS FOR DRUM	23	
7	04-156	FASTENERS FOR DRUM	18	
8	04-158	FASTENERS FOR DRUM	18	
9	04-176	BOILER DRUM-LP	21021	
10	07-206	RISER PIPES - HP	9375	
11	07-207	RISER PIPES - IP	1866	
12	07-208	RISER PIPES - LP	3573	
13	07-210	RISER HEADERS -HP	15255	
14	07-211	RISER HEADERS -IP	1798	
15	07-212	RISER HEADERS -LP	2715	
16	07-411	DOWNCOMER SUSPENSION	7000	
17	07-412	DOWNCOMER SUSPENSION	2500	
18	07-413	DOWNCOMER SUSPENSION	3000	
19	07-504	EVAP. MODULE SUPPORT	3500	
20	07-505	EVAP. MODULE SUPPORT	7640	
21	07-506	EVAP. MODULE SUPPORT	1519	
22	07-507	EVAP. MODULE SUPPORT	1823	
23	07-508	EVAP. MODULE SUPPORT	3690	
24	07-510	EVAP. MODULE SUPPORT	964	
25	07-992	IMPORTED ELECTRODES	25	
26	07-993	ERECTION MATERIALS	477	
27	08-910	EXPN MOVEMENT MEASURING	1933	
28	10-121	HPSH - II INLET HDR	5500	
29	10-135	HPSH - IA INLET HDR	2500	
30	10-221	HPSH - II OUTLET HDR	8000	
31	10-235	HPSH - IA OUTLET HDR	10500	
32	10-236	HPSH - IB OUTLET HDR	5500	
33	12-850	HP SAT. STEAM CONNECTING LINK	5700	
34	12-851	HP MAIN STEAM LINE	5300	

35	12-852	HP SH DE SUPERHEATER	13600	
36	12-853	LP SAT. STEAM CONNECTING LINK	2400	
37	12-854	LP MAIN STEAM LINE	1300	
38	12-855	IP SAT. STEAM CONNECTING LINK	1700	
39	12-856	IP MAIN STEAM LINE	1800	
40	12-900	HP SH DE SUPERHEATER	2100	
41	12-901	HP SH. LINK SUPPORTS	2250	
42	12-902	IP SH. LINK SUPPORTS	1250	
43	12-904	LP SH. LINK SUPPORTS	1500	
44	12-911	LP SH MODULE SUPPORTS	1000	
45	12-912	IP SH MODULE SUPPORTS	236	
46	12-913	HP SH MODULE SUPPORTS	2551	
47	12-992	IMPORTED ELECTRODES	25	
48	12-993	ERECTION MATERIALS	700	
49	15-138	RH-II INLET HDR	8000	
50	15-174	RH-I INLET HDR	6000	
51	15-238	RH-II OUTLET HDR	7000	
52	15-274	RH-I OUTLET HDR	8000	
53	17-852	REHEATER DESH-LINE	22600	
54	17-900	REHEATER DESH	1400	
55	17-901	RH LINK SUPPORT	500	
56	17-904	RH MODULE SUPPORTS	2788	
57	17-993	ERECTION MATERIALS	700	
58	19-101	CPH INLET LINE	2900	
59	19-102	CPH OUTLET LINE	2900	
60	19-850	HP ECONOMISER FEED LINE	2200	
61	19-851	HP ECONOMISER LINK	2400	
62	19-852	HP ECO. I & II	1600	
63	19-853	LP ECONOMISER FEED LINE	400	
64	19-854	IP ECONOMISER FEED LINE	200	
65	19-855	IP ECO LINK TO DRUM	1200	
66	19-856	HP ECO-II & III	1400	
67	19-857	HP ECO-III	1900	
68	19-901	HP ECONOMISER LINE	4500	
69	19-904	LP ECONOMISER LINE	400	
70	19-905	IP ECONOMISER LINE	500	
71	19-908	SUPPORTS FOR CP	300	
72	19-911	CPH MODULE SUPPORTS	4500	
73	19-912	HP ECO-III MODULE	3812	
74	19-913	HP ECO-III MODULE	1706	
75	19-914	HP ECO-II MODULE	2596	
76	19-915	HP ECO-I MODULE	242	
77	19-916	IP ECO MODULE SUPPORTS	652	
78	19-992	IMPORTED ELECTRODES	20	
79	19-993	ERECTION MATERIALS	400	

80	24-200	DRAINS,VENTS & JOINTS	5000	
81	24-201	BOILER TRIM PIPE	1500	
82	24-220	LP SAFETY VALVE	1600	
83	24-225	LP SAFETY VALVE	2000	
84	24-260	LP VALVES	5000	
85	24-273	LP DRUM WATER LEVEL	300	
86	24-275	LP DRAIN HEADER	400	
87	24-280	LP SAFETY VALVE	500	
88	24-285	LP SAFETY VALVE	2500	
89	24-290	LP START-UP VENT	1200	
90	24-300	DRAINS,VENTS & TRIM PIPING	6000	
91	24-301	BOILER TRIM PIPE	1500	
92	24-320	IP SAFETY VALVE	3500	
93	24-325	IP SAFETY VALVE	2500	
94	24-360	BHEL VALVES	5000	
95	24-373	IP DRUM WATER LINE	300	
96	24-375	IP DRAIN HEADER	500	
97	24-380	IP SAFETY VALVE	500	
98	24-385	IP SAFETY VALVE	3500	
99	24-390	IP START-UP VENTS	1500	
100	24-400	HP DRAINS,VENTS	18000	
101	24-401	BLR TRIM PIPING	3000	
102	24-420	HP SAFETY VALVE	5000	
103	24-425	HP SAFETY VALVE	3500	
104	24-460	BHEL VALVES	10000	
105	24-465	BELLOWS& VALVES	8000	
106	24-473	HP DRUM LEVEL GUAGE	300	
107	24-475	HP DRAIN HEADER	600	
108	24-480	HP SAFETY VALVE	1200	
109	24-485	HP SAFETY VALVE	4000	
110	24-490	HP START-UP-VENT	2000	
111	24-955	LAPPING TOOLS	200	
112	24-960	LAPPING TOOLS	300	
113	24-989	COMMISSINING SPARES	200	
114	24-992	IMPORTED ELECTRODES	45	
115	24-993	ERECTION MATERIALS	2000	
116	24-994	NAME PLATES	150	
117	28-700	PINS AND BPS COMPNTS	11739	
118	32-010	FIXG COMP I/L DUCT SIDE	7165	
119	32-110	FIXG COMP I/L DUCT TOP	4509	
120	32-210	FIXG COMP I/L DUCT BOTM	2942	
121	32-310	FIXG COMP CASNG-SH	4425	
122	32-410	FIXG COMP CASNG-HPEVAP	7094	
123	32-510	FIXG COMP CASNG-IPEVAP	6178	
124	32-520	FIXG COMP CASNG-LPEVAP	5492	
125	32-610	FIXG COMP PIPG INSLN	30000	
126	32-710	FIXG COMP CASNG-HPECO	2573	

127	32-720	FIXG COMP O/L DUCT	3263	
128	32-810	FIXG COMP O/L DUCT	1778	
129	32-910	FIXG COMP CASNG-CPH	5503	
130	32-993	ERECTION MATLS	941	
131	33-021	ID CERAMIC WOOL	84216	
132	33-621	MINL WOOL FOR PIPNG	80000	
133	33-970	WIRE MESH	1050	
134	33-975	SEALING COMPNTS	200	
135	35-010	BLR FOUNDATION	16524	
136	35-110	MAIN COLUMN LEF	165671	
137	35-120	MAIN COLUMN RIG	157521	
138	35-130	INLET DUCT COLUMN	29970	
139	35-140	AUX COLUMNS	5790	
140	35-220	PR.PARTS SUPPORTS	70000	
141	35-390	MODULE UPRIGHT FRAME	9500	
142	35-391	MODULE TRANSPORT STRUCTURE	190000	
143	35-392	SINGLE MODULE HANDLING FRAME	4500	
144	35-520	COLUMN SIDE BRACING	3578	
145	35-591	BOTTOM BRACING	45371	
146	35-592	TOP BRACING BEAM	84581	
147	35-593	CROSS BEAMS	27195	
148	35-594	STIFFENER BEAMS	62502	
149	35-595	STACKING BEAM	24717	
150	35-596	PACKING BEAM	116795	
151	35-597	PR.PART SUPPORT	43946	
152	35-610	BOILER ROOF STR	19700	
153	35-611	BOILER ROOF SHEET	12500	
154	36-210	MAIN FLOOR I LEVEL	6000	
155	36-220	MAIN FLOOR II LEVEL	10000	
156	36-230	MAIN FLOOR III	5000	
157	36-240	MAIN FLOOR IV LEVEL	12000	
158	36-250	MAIN FLOOR V LEVEL	20000	
159	36-390	MISC.PLATFORMS	5000	
160	36-810	FLOORGRILLS&GUAGE	60000	
161	36-820	STAIRS AND LADD	5600	
162	36-850	PLATFORMS AND LINE	18000	
163	37-810	AL OUTR CASNG SHEET	19000	
164	48-200	INSTRMNT TAPNGS	300	
165	48-422	HRSG I/L DUCT	61000	
166	48-424	EXPN JOINT I/L DUCT	1000	
167	48-452	DUCT HRSG O/L	12377	
168	48-454	EXPN PECS HRSG O/L	1900	
169	48-493	stack closure damper	10000	
170	48-700	BULKED BPS COMPNTS	114	
171	48-993	ERECTION MATLS	1703	

172	80-145	EXHAUSTS AND VE	4000	
173	80-273	BLOW DOWN SYSTE	500	
174	80-274	CBD TANK SAFETY	50	
175	80-992	IMP0RTED ELECTR	3	
176	81-005	IBD TANK	3500	
177	81-411	BLOW DOWN TANK	120	
178	81-413	BDT CONTROL VALVE	100	
179	87-010	CHIMNEY FDN MAT	18400	
180	87-100	CHIMNEY SHELL	315000	
181	87-150	CHIMNEY STRAKES	42000	
182	87-200	PAINTERS TROLLY	3000	
183	87-300	PLATFORMS &LADD	10500	
184	87-930	CHIMNEY STRAKES	1000	
185	87-950	PAINTERS TROLL	88000	
186	87-960	PLATFORMS &LADD	9000	
188	97-402	EWLI	500	
189	97-411	CONTROL INSTRUMENTS	700	
190	97-414	TEMPERATURE SENSOR	550	
191	97-416	FLOW ELEMENTS A	100	
192	97-417	CONDENSING POT	75	
193	97-418	INTRASCOPE	20	
194	97-433	ERV CONTROLLER	50	
201	HL-098	LOOSE COMPNTS-DUCT	15000	
202	HL-101	EVAPORATOR MODULE	90598	
203	HL-102	EVAPORATOR MODULE	90598	
204	HL-103	EVAPORATOR MODULE	90598	
205	HL-104	EVAPORATOR MODULE	52765	
206	HL-105	EVAPORATOR MODULE	52765	
207	HL-106	EVAPORATOR MODULE	52765	
208	HL-111	EVAPORATOR MODULE	35057	
209	HL-112	EVAPORATOR MODULE	35057	
210	HL-113	EVAPORATOR MODULE	35057	
211	HL-114	EVAPORATOR MODULE	42062	
212	HL-115	EVAPORATOR MODULE	42062	
213	HL-116	EVAPORATOR MODULE	42062	
214	HL-121	EVAPORATOR MODULE	84146	
215	HL-122	EVAPORATOR MODULE	84146	
216	HL-123	EVAPORATOR MODULE	84146	
217	HL-124	EVAPORATOR MODULE	21033	
218	HL-125	EVAPORATOR MODULE	21033	
219	HL-126	EVAPORATOR MODULE	21033	
220	HL-131	HP SH-II MODULE	16278	T91 material
221	HL-132	HP SH-II MODULE	16278	T91 material
222	HL-133	HP SH-II MODULE	16278	T91 material
223	HL-134	HP SH-I MODULE	23291	T91 material
224	HL-135	HP SH-I MODULE	23291	T91 material
225	HL-136	HP SH-I MODULE	23291	T91 material

226	HL-141	LP SH MODULE ASSY	5579	
227	HL-142	LP SH MODULE ASSY	5579	
228	HL-143	LP SH MODULE ASSY	5579	
229	HL-147	IP SH MODULE ASSY	7035	
230	HL-148	IP SH MODULE ASSY	7035	
231	HL-149	IP SH MODULE ASSY	7035	
232	HL-151	HP ECO-III MODULE	82283	
233	HL-152	HP ECO-III MODULE	82283	
234	HL-153	HP ECO-III MODULE	82283	
235	HL-154	HP ECO-III MODULE	37402	
236	HL-155	HP ECO-III MODULE	37402	
237	HL-156	HP ECO-III MODULE	37402	
238	HL-157	HP ECO-II MODULE	74781	
239	HL-158	HP ECO-II MODULE	74781	
240	HL-159	HP ECO-II MODULE	74781	
241	HL-161	HP ECO-I MODULE	7478	
242	HL-162	HP ECO-I MODULE	7478	
243	HL-163	HP ECO-I MODULE	7478	
244	HL-164	IP ECO. MODULE	12361	
245	HL-165	IP ECO. MODULE	12361	
246	HL-166	IP ECO. MODULE	12361	
247	HL-171	CPH MODULE ASSY	178000	
248	HL-172	CPH MODULE ASSY	178000	
249	HL-173	CPH MODULE ASSY	178000	
250	HL-181	RH-II MODULE ASSY	20678	T91 material
251	HL-182	RH-II MODULE ASSY	20678	T91 material
252	HL-183	RH-II MODULE ASSY	20678	T91 material
253	HL-184	RH-I MODULE ASSY	22031	T91 material
254	HL-185	RH-I MODULE ASSY	22031	T91 material
255	HL-186	RH-I MODULE ASSY	22031	T91 material
256	HL-201	LINKS FOR EVAP.	3973	
257	HL-202	LINKS FOR EVAP.	3973	
258	HL-203	LINKS FOR EVAP.	3973	
259	HL-204	LINKS FOR EVAP.	15231	
260	HL-205	LINKS FOR EVAP.	3590	
261	HL-206	LINKS FOR EVAP.	15231	
262	HL-211	LINKS FOR EVAP.	286	
263	HL-212	LINKS FOR EVAP.	286	
264	HL-213	LINKS FOR EVAP.	286	
265	HL-214	LINKS FOR EVAP.	3966	
266	HL-215	LINKS FOR EVAP.	1011	
267	HL-216	LINKS FOR EVAP.	3965	
268	HL-221	LINKS FOR EVAP.	292	
269	HL-222	LINKS FOR EVAP.	292	
270	HL-223	LINKS FOR EVAP.	292	
271	HL-224	LINKS FOR EVAP.	2103	
272	HL-225	LINKS FOR EVAP.	670	

273	HL-226	LINKS FOR EVAP.	2102	
274	HL-231	HP SH-II CROSSO	6200	
275	HL-232	HP SH-II CROSSO	6200	
276	HL-233	HP SH-II CROSSO	6200	
277	HL-234	HP SH-I CROSSOV	6200	
278	HL-235	HP SH-I CROSSOV	6200	
279	HL-236	HP SH-I CROSSOV	6200	
280	HL-251	HP ECO-III CROS	700	
281	HL-252	HP ECO-III CROS	700	
282	HL-253	HP ECO-III CROS	700	
283	HL-254	HP ECO-III CROS	700	
284	HL-255	HP ECO-III CROS	700	
285	HL-256	HP ECO-III CROS	700	
286	HL-257	HP ECO-II CROSS	1000	
287	HL-258	HP ECO-II CROSS	1000	
288	HL-259	HP ECO-II CROSS	1000	
289	HL-264	IP ECO. CROSS O	250	
290	HL-265	IP ECO. CROSS O	250	
291	HL-266	IP ECO. CROSS O	250	
292	HL-271	LINKS FOR CPH MODULE	2000	
293	HL-272	LINKS FOR CPH MODULE	2000	
294	HL-273	LINKS FOR CPH MODULE	2000	
295	HL-281	RH-II CROSS OVER	3186	
296	HL-282	RH-II CROSS OVER	3186	
297	HL-283	RH-II CROSS OVER	3186	
298	HL-284	RH-I CROSS OVER	3421	
299	HL-285	RH-I CROSS OVER	3421	
300	HL-286	RH-I CROSS OVER	3421	
301	HL-301	MODULE COMPNTS-	1735	
302	HL-302	MODULE COMPNTS-	3000	
303	HL-303	MODULE COMPNTS-	1735	
304	HL-304	MODULE COMPNTS-	2932	
305	HL-305	MODULE COMPNTS-	3000	
306	HL-306	MODULE COMPNTS-	2932	
307	HL-311	MODULE COMPNTS-	2095	
308	HL-312	MODULE COMPNTS-	8684	
309	HL-313	MODULE COMPNTS-	2095	
310	HL-321	MODULE COMPNTS-	2732	
311	HL-322	MODULE COMPNTS-	3000	
312	HL-323	MODULE COMPNTS-	2732	
313	HL-331	HP SH MODULE COMPONENTS	900	T91 material
314	HL-332	HP SH MODULE COMPONENTS	900	T91 material
315	HL-333	HP SH MODULE COMPONENTS	900	T91 material
316	HL-351	HP ECO-III MODULE	2200	
317	HL-352	HP ECO-III MODULE	2200	
318	HL-353	HP ECO-III MODULE	2200	
319	HL-354	HP ECO-III MODULE	2200	

320	HL-355	HP ECO-III MODULE	2200	
321	HL-356	HP ECO-III MODULE	2200	
322	HL-357	HP ECO-II MODULE	2200	
323	HL-358	HP ECO-II MODULE	2200	
324	HL-359	HP ECO-II MODULE	2200	
325	HL-371	LINKS FOR CPH MODULE	3000	
326	HL-372	LINKS FOR CPH MODULE	3000	
327	HL-373	LINKS FOR CPH MODULE	3000	
328	HL-501	SIDE CASNG-S1/S2	7723	
329	HL-502	SIDE CASNG-S2/S3	7593	
330	HL-503	SIDE CASNG-S3/S4	7593	
331	HL-504	SIDE CASNG-S4/S5	6148	
332	HL-505	SIDE CASNG-S5/S6	6148	
333	HL-506	SIDE CASNG-S6/S7	6148	
334	HL-507	SIDE CASNG-S7/S8	6148	
335	HL-508	SIDE CASNG-S8/S9	6148	
336	HL-509	SIDE CASNG-S9/S10	6148	
337	HL-510	SIDE CASNG-S1/S11	12297	
338	HL-601	TOP&BOTM CASNG-S1/S2	8426	
339	HL-602	TOP&BOTM CASNG-S2/S3	6035	
340	HL-603	TOP&BOTM CASNG-S3/S4	6017	
341	HL-604	TOP&BOTM CASNG-S4/S5	5362	
342	HL-605	TOP&BOTM CASNG-S5/S6	5362	
343	HL-606	TOP&BOTM CASNG-S6/S7	5362	
344	HL-607	TOP&BOTM CASNG-S7/S8	5390	
345	HL-608	TOP&BOTM CASNG-S8/S9	5350	
346	HL-609	TOP&BOTM CASNG-S9/S10	5390	
347	HL-610	TOP&BOTM CASNG-S10/S11	5200	
		Total Weight in Kgs	5436886	**Say 5430 MT**

Note : HP Super-heater & Re-heater modules are of SA 213 T91 material. Welding of T91 material is envisaged for these modules. The contractor has to carry out the work for the same including supply of all the consumables for completing the process. The HT, RG and NDT will have to be carried out by the contactor as per welding specifications. Finally accepted rate against Item no 1 of rate schedule shall be applicable for erection, welding of these modules & links also.

BB) DETAILS REGARDING 70 M HIGH CHIMNEY FOR HRSG

THE DETAILS OF CHIMNEY IS AS FOLLOWS:

CHIMNEY INNER DIAMETER : 6.5 M
CHIMNEY TOTAL HEIGHT : 70 M
TOTAL CHIMNEY ESTIMATED PGMA WEIGHT : 490 MT
TOTAL NUMBER OF SHELLS : 28
CHIMNEY BASE : 50 mm Thick

SHELL THICKNESS VARIOUS AS FOLLOWS :

32mm Thick Shell	:	3nos
28mm Thick Shell	:	3nos
25mm Thick Shell	:	6nos
20mm Thick Shell	:	4nos
16mm Thick Shell	:	3nos
14mm Thick Shell	:	9nos

- TOTAL SHELL WEIGHT : 315 MT Approx.

- EACH SHELL WILL BE 2.5 M HIGH AND SHELLS ARE SENT IN TWO HALVES.

- ALL SHELLS ARE TO BE WELDED AS PER ERECTION DETAIL.FLANGE HOLES ARE GIVEN FOR LOCATING/ ERECTION/ ALIGNMENT PURPOSE ONLY.
- WELDING OF CHIMNEY JOINTS SHALL BE CARRIED OUT BY CERTIFIED WELDER..
- CHIMNEY HAS TO BE INSULATED UPTO FULL HEIGHT AND APPROXIMATE . INSULATION THICKNESS: IS 80mm LRB WOOLMATTRESS, HOWEVER ACTUAL INSULATION THICKNESS SHALL BE AS PER DRAWINSG WHICH WILL BE PROVIDED DURING EXECUTION OF WORK AT SITE.
- HELICAL STRAKES AS INDICATED IN THE ERECTION DRAWINGS ARE TO BE WELDED ONTO THE CHIMNEY.
- CHIMNEY BASE WILL BE SUPPLIED IN TWO HALVES, WHICH WILL HAVE TO BE ASSEMBLED AT SITE.
- PAINTERS TROLLEY WILL BE SUPPLIED IN PARTS AND WILL HAVE TO BE ASSEMBLED.
- ALL ELECTRICAL WORKS SUCH AS LIGHTENING ARRESTORS, EARTHING AND AVIATION LIGHTS ETC IS IN THE SCOPE OF WORK.
- STACK/ CHIMNEY HAVE TO BE PAINTED AS PER THE REQUIREMENT OF AVIATION / RELEVANT BIS STANDARDS.
- STEEL MAIN STACK IS INSULATED FOR FULL HEIGHT

NOTE: Above details are only to give a general idea to the contractor to quote the rates as per rate schedule. Besides PGs indicated above, there is likelihood of addition of new PGs for release of some items integral to HRSG. Contractor is required to carryout such PGs also within their applicable tonnage rate. The decision of BHEL regarding inclusion of new / additional PG will be final & binding on the contractor. Certain items like insulation material, cladding, valves etc. may be supplied by other suppliers / BHEL units like PEM etc. as per PGMA applicable for HRSG system. Such items are also to be erected as per tonnage rates & as directed by BHEL. No extra claim shall be entertained on this account.

WEIGHT SCHEDULE
(PIPING SYSTEMS)

AA: SUMMARY OF WEIGHTS

Total weight to be erected for 4 no. HRSG : 1828 MT

BB: Product Group (PG) Wise Weight Schedule For each Boiler

PGMA	DESCRIPTION	WT (MT)	REMARKS
80304	MS INCLUDING MS HEADER TO HPBP VALVE	250	**P91**
80307	HP & LP BYPASS WARM UP	10	
80310	HRH FROM REHEATER TO INTERCEPTOR VALVE	440	
80312	LPBP VALVE UPSTREAM & DOWNSTREAM	90	
80320	CRH FROM TURBINE TO REHEATER	125	
80321	HPBP VALVE TO CRH PIPING	36	
80359	STEAM FROM PROCESS BLR	230	
80430	SPRAY WATER TO HPBP	15	
80434	UNLISTED SPRAY WATER - SG SCOPE	6	
80436	SPRAY WATER TO LPBP DESH	5	
80452	HP PIPING DRAINS - SG SCOPE	4	
80453	LP PIPING DRAINS - SG SCOPE	6	
80600	HIGH PRESSURE DOSING PIPING	2	
80601	LOW PRESSURE DOSING PIPING	1	
80612	SERVICE AIR FOR INDIVIDUAL UNITS	8	
80616	INSTRUMENT AIR FOR INDIVIDUAL UNIT	8	
80901	SUB DELIVERY VALVES FOR LIGHT UP	2	
80922	H&S FOR LIGHT UP - NON STEAM LINES	450	
	MINERAL WOOL BONDED + CLADDING FOR INSULATION	140	
	TOTAL	**1,828.0**	

NOTES:

a) All the above systems of piping include the erection of pipes, bends, valves, fittings, impulse piping and including root valves, sampling lines, drains, hangers and supports & other accessories so as to make the systems complete in all respect.

b) Above system of piping can be regrouped / renamed or any addition / deletion in the system can be made in order to make system complete as per requirement. No extra cost shall be entertained on this account.

c) The piping systems mentioned above are only indicative and does not cover all the piping systems to be erected / commissioned. Contractors are however required to erect commission all piping systems shown in drawings & other documents which may be necessary for erection, completion & overall commissioning Of combined cycle at the accepted unit rates.

d) The tonnages indicated are tentative only and may vary during execution of work. The contractor is required to erect / commission all piping systems shown in drawings and documents which may be necessary for overall commissioning of HRSG. Payment shall be released on the basis of actual work executed as per final accepted rates.

e) Bidders may note above while quoting / accepting tonnage rates for subject work.

LIST OF T&P BEING PROVIDED BY BHEL ON FREE OF HIRE CHARGES AND ON SHARING BASIS

Equipment	Capacity	Qty.
Crawler crane	200 / 250 T	1No.
Crawler crane	75 / 100 / 150 T	1No.
Hydrotest pump set	250 / 400 kg	1No
Chemical cleaning arrangement	Chemical cleaning shall be carried out by a separate agency appointed by BHEL . **(refer Clause No 44.4)**	
Equipment for P91 piping system	3 sets, as per requirement **(refer Clause No 53.8)**	

NOTE:

1) Any other special T&P if supplied by Manufacturer will also be provided free of hire charges as and when made available. These special tools & tackles are to be used only for the purpose for which these are meant and are to be required to be returned in good condition as and when required by BHEL.
2) Other terms & conditions regarding above items shall be as per clause no 37 (T & P / IMTE's)
3) The operation of 200 / 250 MT crane shall be carried out by BHEL. However, fuel for operation of crane shall be provided by the Contractor at his cost. The lubricants shall be issued by BHEL.
4) Although BHEL will organize maintenance of 200/250 T crane, Contractor at his cost will provide all support (manpower /T&P etc.) for the same.
5) In case of requirement of any additional higher capacity crane for erection of HP boiler drum (envisaged to be erected using two cranes in tandem operation), same shall be arranged by BHEL.

LIST OF MAJOR T&P TO BE ARRANGED BY CONTRACTOR AT HIS COST

Equipment	Capacity	Qty.
CRAWLER CRANE	75 T	1NO. FROM START
HYDRA CRANE	8T	2NO. (1NO. FROM START FURTHER AS PER SITE REQUIREMENT
TYRE MOUNTED MOBILE CRANE	15 / 18T	2NO. (1NO. FROM START FURTHER AS PER SITE REQUIREMENT)
TRAILER WITH PULLING UNIT (20/25 T)		FROM START OF PROJECT
TRAILER WITH PULLING UNIT (10/15 T)		FROM START OF PROJECT
ELECTRIC WINCH 2/3/5 T		AS PER REQUIREMENT
WELDING SETS WITH ACCESSORIES		AS PER REQUIREMENT
POWER DRILL MACHINE FOR PLATFORM GRILL & ROOF		1 NO.

NOTE:

1. The above list specifies only major T&P (may not be complete) to be deployed by the contractor. All additional / other T&P which are required for satisfactory & timely completion of works shall be deployed by the contractor within finally accepted rate/ prices.

2. For other terms & Conditions regarding above items please refer clause 37.

Annexure-IV

TENTATIVE LIST OF MAJOR IMTE's TO BE ARRANGED BY CONTRACTOR AT HIS OWN COST

Equipment	Capacity / Range	Qty.
Hand operated megger	500V/1 KV	As per requirement
Tong tester	10,20 or 50 A	As per requirement
Digital multimeter	3 ½ digit	As per requirement
6 / 12 Point temperature recorder for stress relieving	0 to 1000 degree C	As per requirement
ALCHOMETER		As per requirement

NOTE:

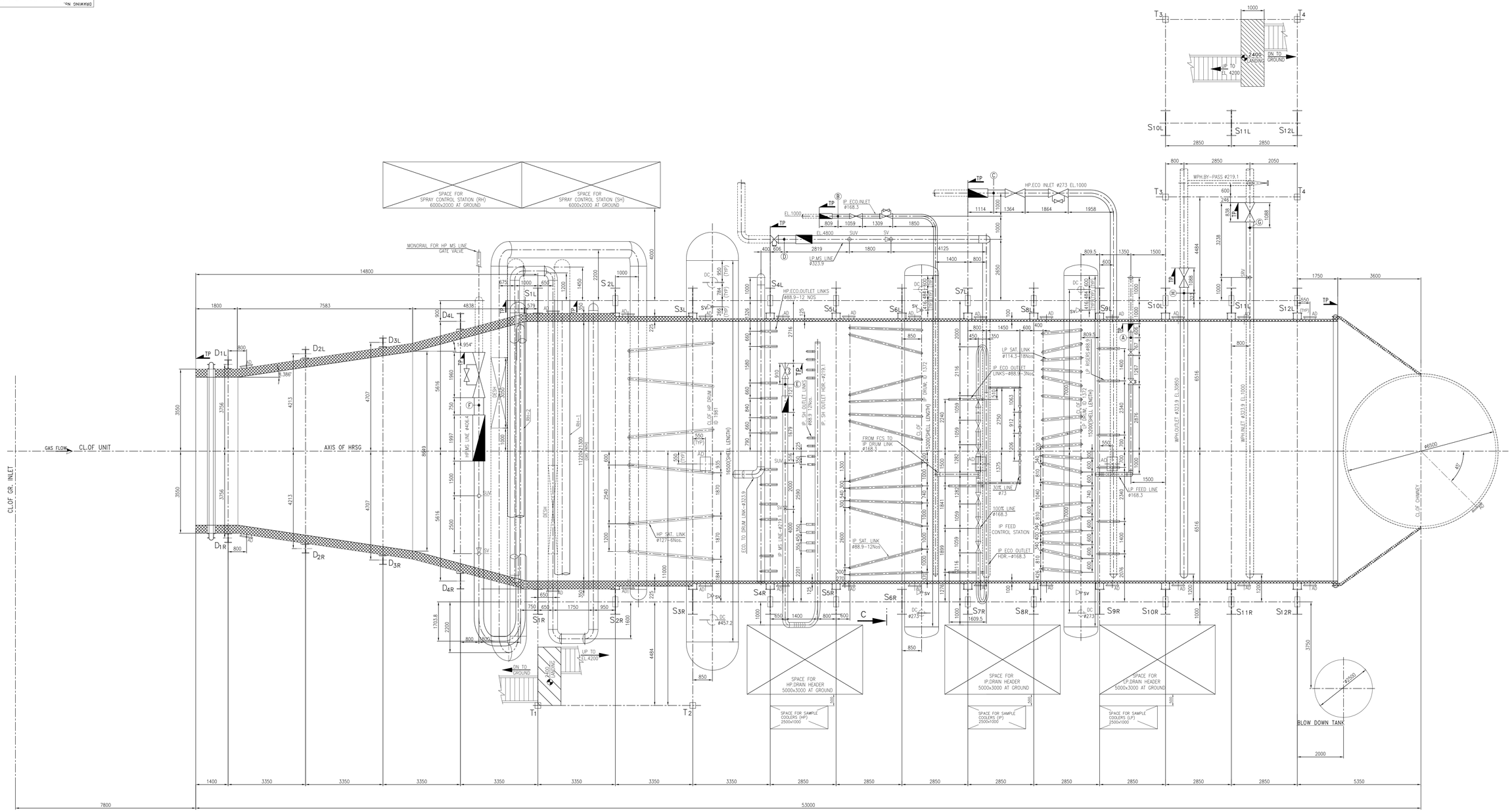
1. The above list specifies only major IMTEs (may not be complete) to be deployed by the contractor. All additional / other T&P which are required for satisfactory & timely completion of works shall be deployed by the contractor within finally accepted rate/ prices.

2. For other terms & Conditions regarding above items please refer clause 37.

Annexure-V

LIST OF DRAWINGS / STANDARD SPECIFICATIONS

S.N0	TITLE	NO OF SHEETS
1.	GENERAL ARRANGMENT OF BOILER - PLAN (0-00-561-93369)	1
2.	GENERAL ARRANGMENT OF BOILER - ELEVATION (0-00-561-93368)	1
3.	GENERAL ARRANGMENT OF HRSG STEEL CHIMNEY (0-87-100-80208)	1
4.	TECHNICAL SPECIFICATIONS FOR POWER CYCLE PIPING (CW-CM-9472-C-O-M-001, VOLUME-1, CHAPTER M4)	41
5.	TECHNICAL SPECIFICATIONS FOR LOW PRESSURE PIPING (CW-CM-9472-C-O-M-001, VOLUME-1, CHAPTER M5)	37
6.	TECHNICAL SPECIFICATIONS FOR PAINTING (CW-CM-9472-C-O-M-001, VOLUME-1, CHAPTER M21)	14
7.	ERECTION CONDITIONS OF CONTRACT (CW-CM-9472-C-O-M-001, VOLUME VIII)	74



NOTES.

1. SECTION AA, BB, CC & DD ARE SHOWN IN THE DRAWING No. 0-00-561-93370 (GENERAL ARRANGEMENT OF BOILER-SECTIONS)
2. SPACE IDENTIFIED FOR VARIOUS EQUIPEMENTS ARE AT GROUND, UNLESS OTHERWISE SPECIFIED.
3. (A)(B)(C)(D)(E)(F)(G)&(H) ARE DESIGNATIONS OF ANCHOR POINTS.

REFERENCE DRAWINGS

1. GENERAL ARRANGEMENT OF BOILER – ELEVATION – – – – – 0-00-561-93368

CUSTOMER No. 5722,23,24&25

REV	DATE	ALTD
		CHD
ZONE		APPD

CUSTOMER M/S PRAGATI POWER CORPORATION LTD. BAWANA. DELHI

CONSULTANT NTPC CONSULTANCY DIVISION

PROJECT 1500 MW COMBINED CYCLE POWER PLANT
HEAT RECOVERY STEAM GENERATOR – BEHIND FRAME 9 FA GT.
272.6 t/h, 131.6kg/cm² (g), 540°C/540°C, 38.2 t/h, 29kg/cm² (g), 332°C & 30.5 t/h, 5.6kg/cm² (g) 227.2°C

BHARAT HEAVY ELECTRICALS LTD.,
BOILER PLANT UNIT, TIRUCHIRAPALLI-620 014.
361-245/A

DRAWN	RP.Nathan
CHECKED	P.K.Sahoo
APPROVED	V.Jothimani
DATE 19.06.08	T.Radhakrishnan

TITLE: GENERAL ARRANGEMENT OF BOILER-PLAN

ALL DIMENSIONS ARE IN MILLIMETRES — SCALE 1:60

DRG No. 0-00-561-93369 REV. 00

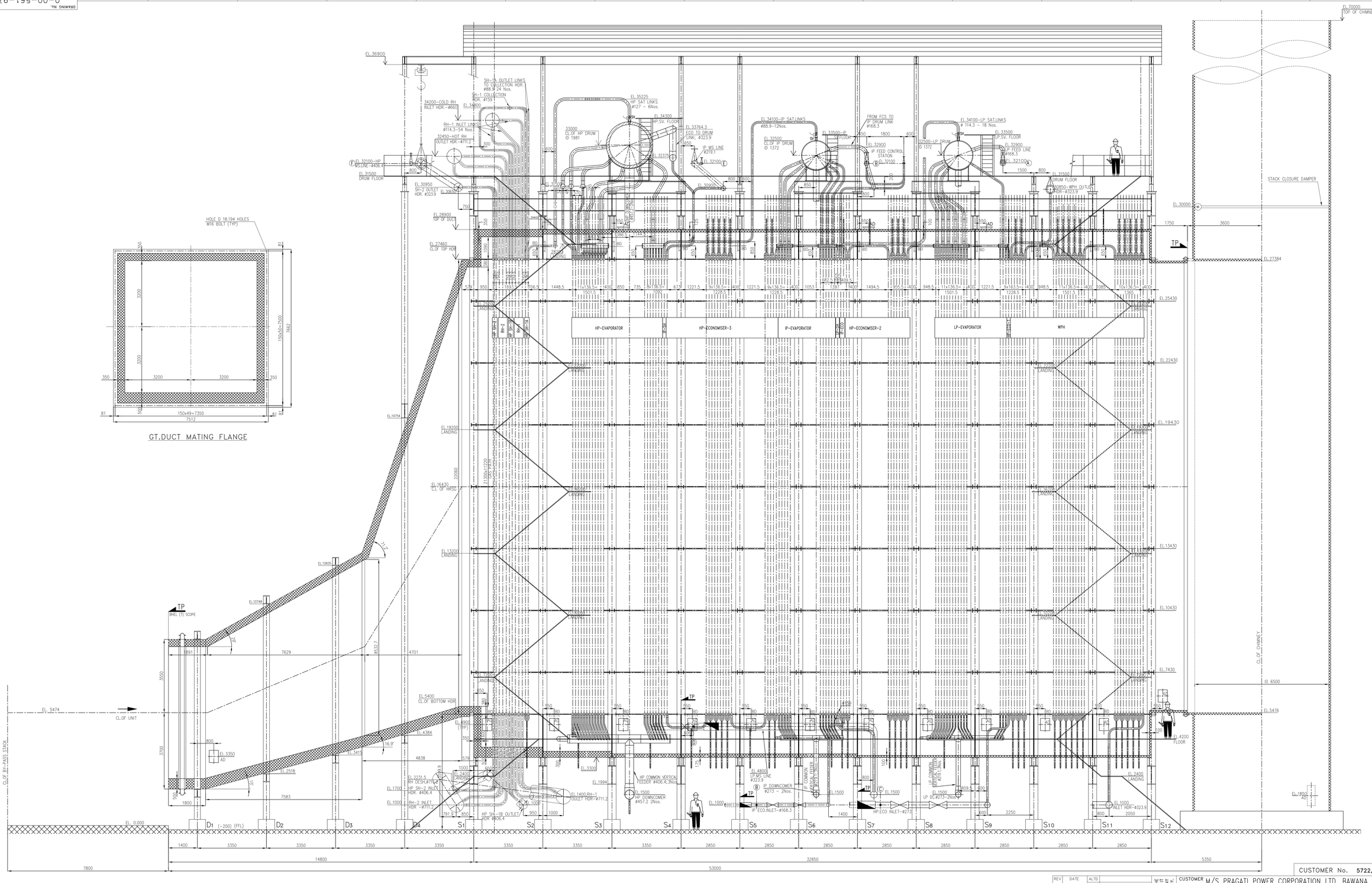
A0 SIZE

DRAWING No. 0-00-561-93368

FIRST ANGLE PROJECTION (ALL DIMENSIONS IN MILLIMETRES)

COMPUTER FILE NAME : H:\LAYBACK\5722\GAELRO.DWG

GT.DUCT MATING FLANGE



DESCRIPTION OF THE UNIT:-

ONE NUMBER OUT DOOR, UNFIRED, WATER TUBE, TRIPLE PRESSURE, TRIPLE WIDTH, REHEAT, NATURAL CIRCULATION, HORIZONTAL TYPE HRSG.

COLUMN SIZE

D1 TO D3	I 300x400
D4	I 300x700
S1 TO S12	I 400x1100

NOTES.

1. ALL ACCESS DOORS ARE LOCATED ON BOTH SIDES UNLESS OTHERWISE (A)-(H)FIED.
2. ALL DIMENSIONS OF DUCT INDICATED REPRESENTS INSIDE SIZE ONLY.
3. TP TERMINAL POINT FOR BHEL / TRICHY SCOPE OF SUPPLY
4. (A)(B)(C)(D)(E) F G &(H) ARE DESIGNATIONS OF ANCHOR POINTS.
5. FINISH FLOOR LEVEL = RL 217.415M,CORRESPONDS TO PLAN EL.0.0M(GROUND FLOOR OF GT BUILDING)
6. FINISHED GROUND LEVEL = 217.215M (GROUND FLOOR OF HRSG)

REFERENCE DRAWINGS

1. GENERAL ARRANGEMENT OF BOILER - PLAN	0-00-561-93369
2. MAIN EQUIPMENT LAYOUT PLAN (POWER BLOCK)	PE-DG-314-100-M002
3. GENERAL ARRANGEMENT GAS TURBINE & GENERATOR	1-366-09-89007
4. GENERAL ARRANGEMENT OF BOILER SECTIONS	0-00-562-93370
5. FLOOR PLAN AT EL.4200	0-00-562-93371
6. FLOOR PLAN AT EL.31500,33500&34300	0-00-562-93372
7. LAYOUT OF DUCTING ELEVATION	0-00-565-93373
8. LAYOUT OF DUCTING PLAN	0-00-565-93374
9. TERMINAL POINT DETAILS	0-00-565-93375

LEGEND

1. ACCESS DOOR (450 x 600)	AD
2. BOLTED DOOR (450 X 450)	BD
3. SAFETY VALVE	SV
4. STARTUP VENT	SUV
5. SAFETY RELIEF VALVE	SRV
6. DOWNCOMER	DC
7. WATER PREHEATER	WPH
8. TERMINAL POINT	TP

REV	DATE	ALTD
		CHD
ZONE		APPD

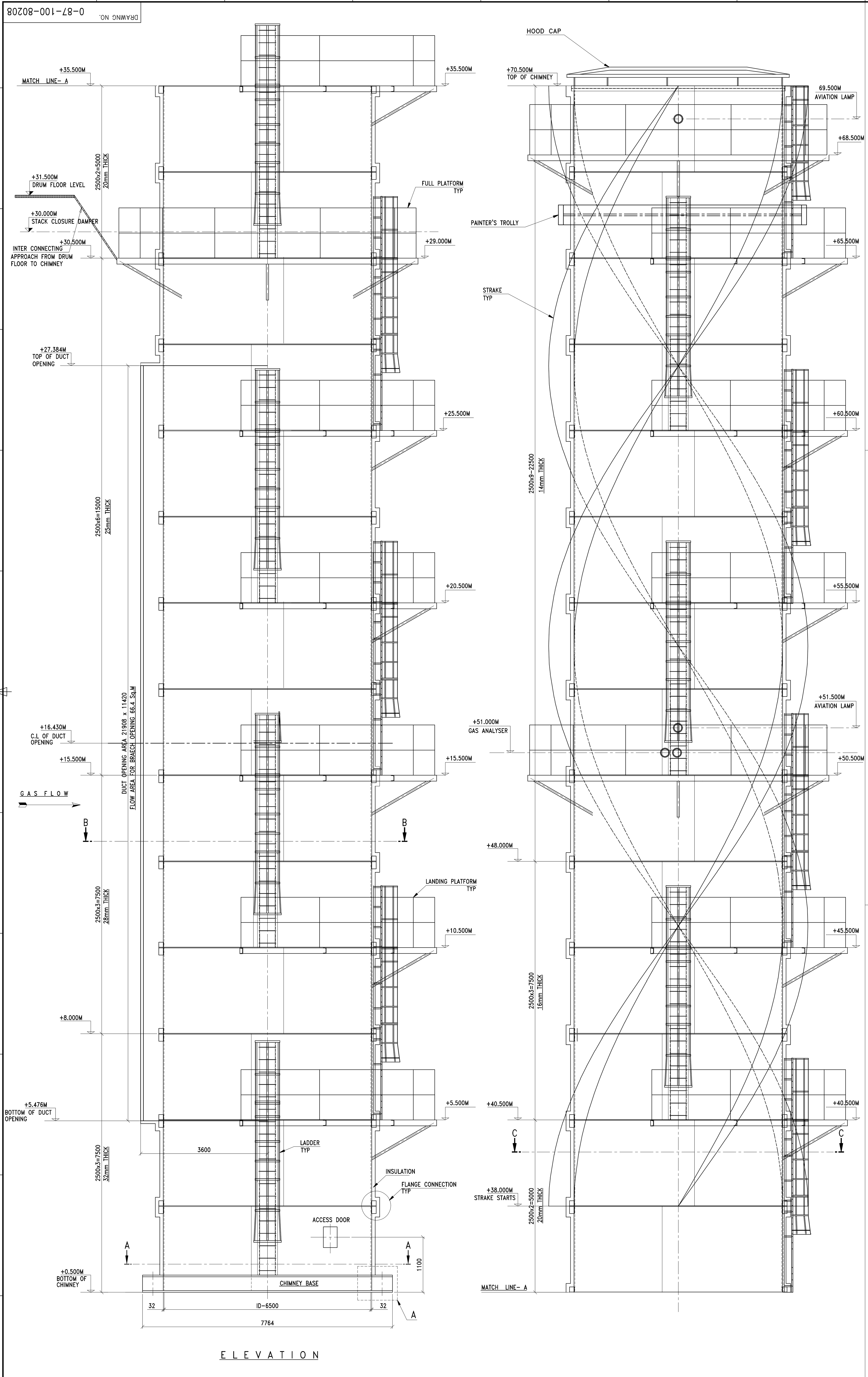
CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

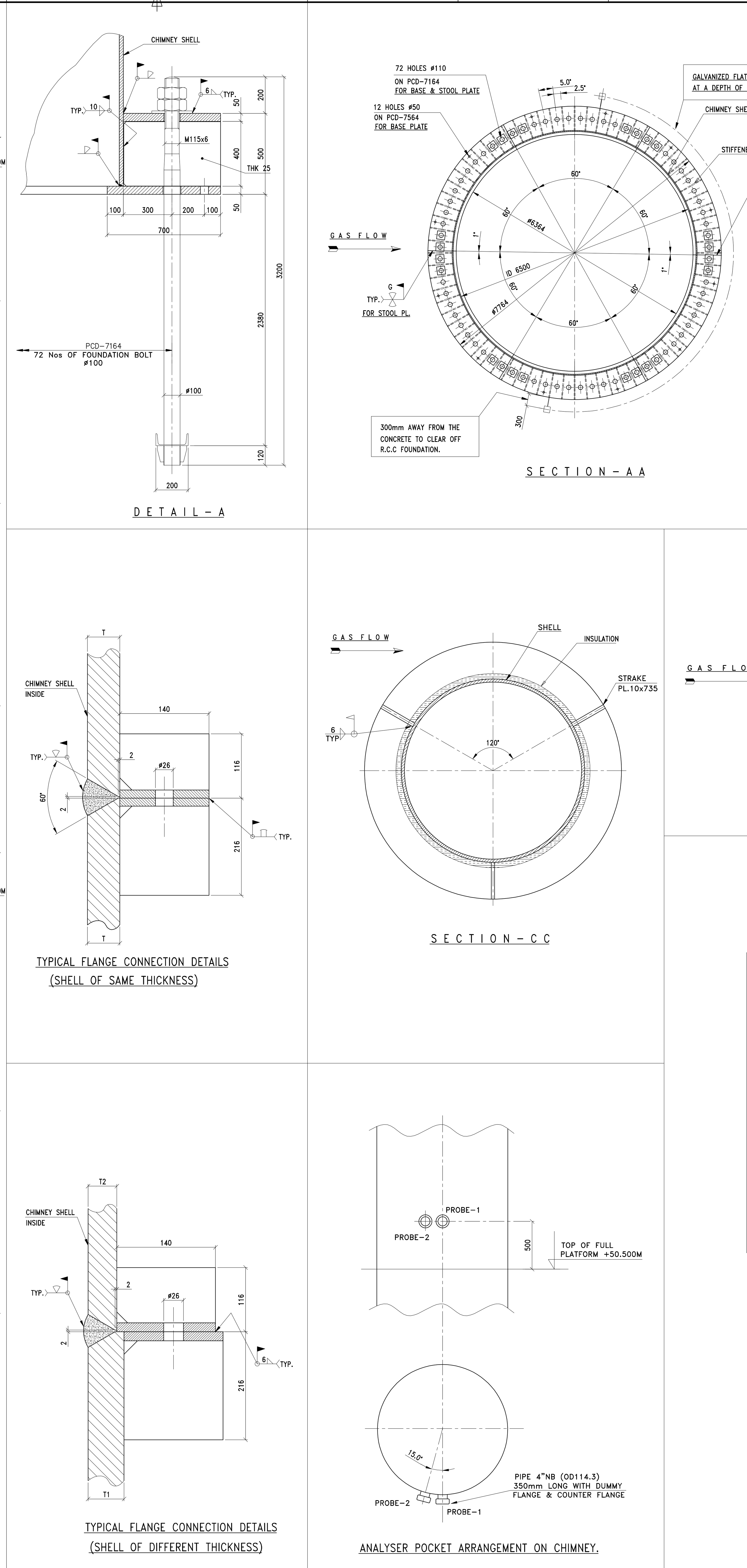
CUSTOMER No. 5722,23,24&25

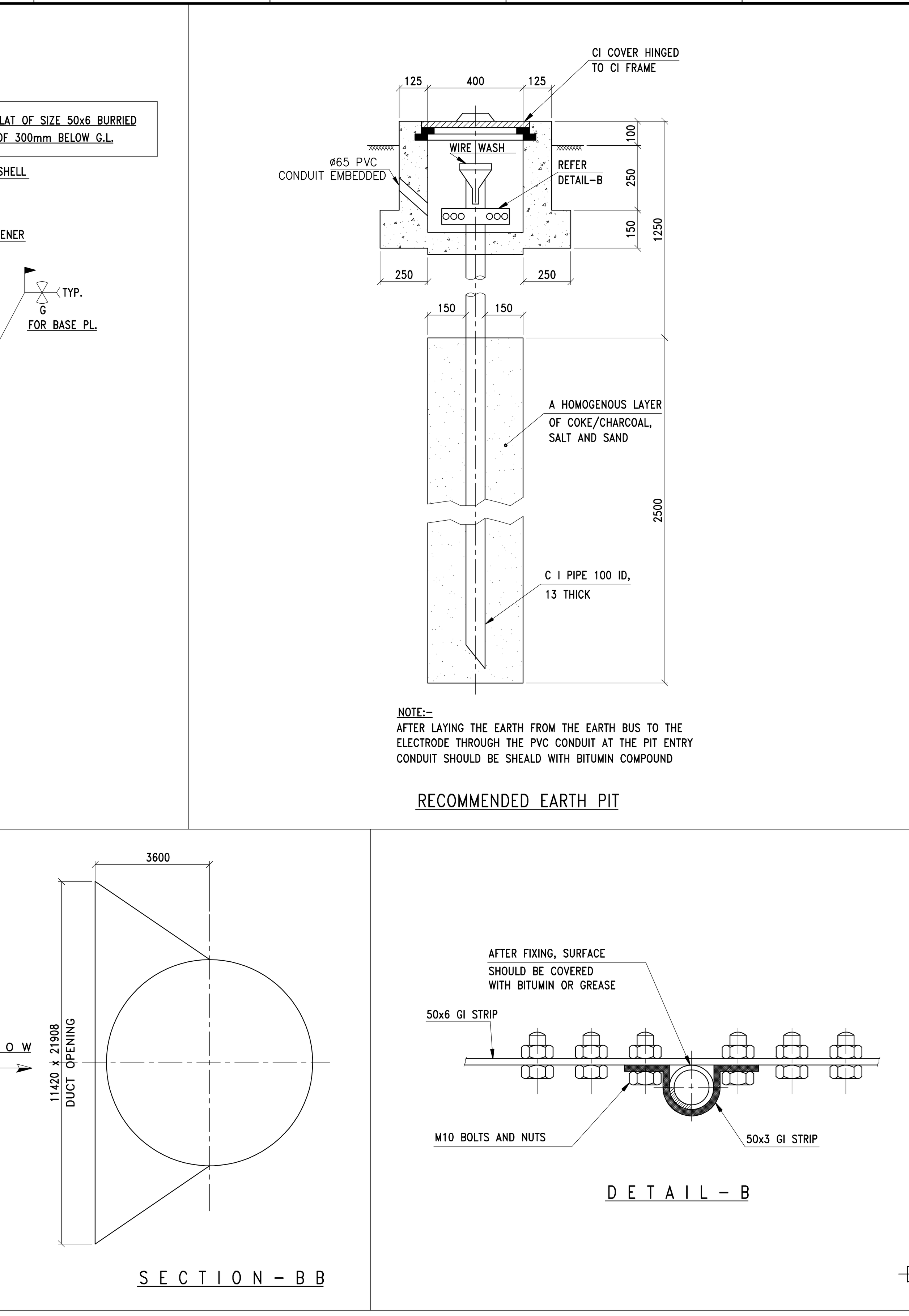
CUSTOMER	M/S PRAGATI POWER CORPORATION LTD. BAWANA. DELHI
CONSULTANT	NTPC CONSULTANCY DIVISION
PROJECT	1500 MW COMBINED CYCLE POWER PLANT HEAT RECOVERY STEAM GENERATOR - BEHIND FRAME 9 FA GT. 272.6 t/h, 131.6kg/cm²(g), 540°C/540°C, 38.2 t/h, 29kg/cm²(g), 330°C & 30.5 t/h, 5.6kg/cm²(g) 227.2°C
	BHARAT HEAVY ELECTRICALS LTD., BOILER PLANT UNIT, TIRUCHIRAPALLI-620 014.
DRAWN	RP.Nathan
CHECKED	P.K.Sahoo
APPROVED	V.Jothimani
DATE 19.06.08	T.Radhakrishnan
ALL DIMENSIONS ARE IN MILLIMETRES	SCALE 1:60
TITLE	GENERAL ARRANGEMENT OF BOILER - ELEVATION
DRG No.	0-00-561-93368
REV.	00

361-245/A

A0 SIZE







NOTES:-

1. ALL SHELL PLATES ARE AS PER IS 2062 SPECIFICATION.
2. FULL PLATFORMS SHALL BE PROVIDED AT +29.00M, +50.50M & +68.50M.
3. LANDING PLATFORM SHALL BE PROVIDED AT +5.50M, +10.50M, +15.50M, +20.50M, +25.50M, +35.50M, +40.50M, +45.50M, +55.50M, +60.50M, & +65.50M.
4. WIDTH OF PLATFORM SHALL BE 1000MM.
5. LRB MINERAL WOOL INSULATION OF 80MM THICK SHALL BE PROVIDED FOR FULL HEIGHT OF CHIMNEY.
6. THE LIGHTING FIXTURES SHALL BE DISTRIBUTED AT INTERVALS OF 120 DEG. IN ONE HORIZONTAL PLANE. EACH LIGHTING FIXTURE SHALL HAVE TWO NEON TYPE LAMPS. THE LIGHTING FIXTURES SHALL BE PROVIDED AT +51.50M & +69.50M.
7. THREE HELICAL CONTINUOUS STRAKES AT 120 DEG. INTERVALS SHALL BE PROVIDED FOR TOP 32.50M HEIGHT.
8. SAMPLING POINTS SHALL BE LOCATED FOR GAS ANALISERS ABOVE PLATFORM AT +50.5M AS PER SKETCH SHOWN.
9. PAINTERS TROLLEY SHALL BE PROVIDED BELOW THE TOP OF FULL PLATFORM AT +68.5M LEVEL.
10. A CIRCUMFERENTIAL CANOPY / HOOD SHALL BE PROVIDED AT TOP OF CHIMNEY.
11. STACK CLOSURE DAMPER SHALL BE PROVIDED AT +30.0M.
12. THE VARIATION IN ECCENTRICITY OF THE AXIS OF THE CHIMNEY FROM THE VERTICAL AT ANY LEVEL SHALL NOT EXCEED 25MM OR 1/1000 OF THE HEIGHT, WHICHEVER IS LESSER AT THE PARTICULAR SECTION.
13. +0.500M LEVEL CORRESPONDS TO BOTTOM OF CHIMNEY BASE PLATE.

ALL DIMENSIONS ARE IN MILLIMETRES

CUST NO: 5722, 5723, 5724, 5725

PRAGATI POWER CORPORATION LIMITED

NTPC-CONSULTANCY WING

PRAGATI - III COMBINED CYCLE POWER PROJECT
1500MW (NOMINAL) AT BAWANA, DELHI

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: BOILER AUXILIARIES PLANT.
RANIPET - 632 406.

	NAME	SIGN	DATE	NO.OF VAR.
DRN	M.K.Nahak		04/11/08	-
CHD	K.B.Padhi		04/11/08	
APPD	S.S.Mani		04/11/08	

DEPT	GRADE OF UNTOL.DIM	SCALE	WEIGHT (KG).	REF. TO ASSY/OLD DRG.	ITEM NO.	NO. OF ITEMS
AQCS, CODE 862	PR: QA: 500	N.T.S	-	-	-	-

REV	DATE	ALTERED / CHECKED
ZONE		

TITLE: GENERAL ARRGT. OF HRSG STEEL CHIMNEY

CARD CODE: U 01

DRAWING NO. 0-87-100-80208

REV 00

Size A0

1.00.00 EQUIPMENT SIZING CRITERIA

1.01.00 General

All the piping systems and equipments supplied shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

The design, Engineering, erection, testing, etc. of the complete piping systems shall be to the requirements of power piping code ASME B 31.1. In addition to this, requirements as laid down in Indian Boiler Regulations (latest edition) shall also be met completely.

1.02.00 Pipe Sizing

Inside diameters of piping shall first be calculated for the flow requirement of various systems. The velocity limits for calculating the inside diameters are listed below.

HP steam, HRH steam, CRH/ IP super Heat Steam and LP steam piping	76 M/sec
HP bypass upstreamHPBP downstream	76 M/sec.100 M/sec
IP Bypass upstreamIP BP downstream	76 M/sec.100 M/sec
LP bypass UpstreamLP bypass Downstream	76 M/sec.100 M/sec.
Auxiliary steam	40 M/sec
Feed Water Suction	2.0-3.0 M/sec
Feed water Discharge & Spray piping	4.0-6.0 M/sec.
Condensate suction	1.5 M/sec
Condensate discharge	3.0-5.0 M/sec
Other piping	as per good engineering practice

Inside diameters thus calculated for various piping systems shall be checked for the allowable pressure drop.

Pipe shall be sized for the worst (i.e. maximum- flow, temperature and pressure values) operating conditions for each system considering the maximum occasional pressure and temperature variations.

The design pressure for BFP discharge piping shall not be less than pressure corresponding to trip speed (for 51.5 Hz) of the pump at minimum recirculation flow.

The Design Pressure of MS Piping from Superheater outlet header up to and including HRSG Stop Valve shall not be less than the design pressure of the final Superheater outlet header.

1.03.00 Material Selection

Piping system shall be of carbon steel for design temperature up to 400 deg. C and alloy steel for design temperature above 400 deg. C.

1.04.00 Pipe Wall Thickness

Thickness calculation shall be on the basis of procedure and formula given in ANSI/ ASME B 31.1. Thickness thus calculated shall then be checked based on the procedure and formula given in IBR. Based on the higher value of the two calculations (after adding manufacturing tolerance), the next heavier commercial wall thickness shall then be selected from thickness schedules (e.g. Sch.-40, Sch-80, etc) as contained in ANSI / ASME B36.10 for OD controlled pipes and from manufactures' schedules for ID controlled pipes.

However, in such cases where the calculated thickness for OD controlled pipe falls beyond the thickness corresponding to the listed schedule nos as given in ANSI B36.10 for the pipe size, both ID and OD controlled pipes to manufactures' schedules are acceptable.

OD controlled pipes shall be to the dimensional standards ANSI B36.10 for carbon & alloy steels pipes and ANSI B36.19 for stainless steel pipes.

To Account for losses due to corrosion, erosion etc. during the plant service life, an allowance of 1.6 mm/0.75mm shall be added to the minimum wall thickness of pipes calculated as per ASME B31.1/IBR respectively.

Further, the design pressure and temperature, down-stream of any pressure reducing valve up to and including the first block valve shall be the same as that at up-stream of pressure reducing valve.

The selected thickness for pipe sizes 50NB & below shall in no case be less than Sch.80 for alloy steel & carbon steel pipes and Sch.40S for SS pipes. However, for IP By Pass & LP Bypass down stream piping, the minimum thickness shall not be less than Sch. XS.

Further, for the piping systems likely to be subjected to two phase flow, i.e. down stream of control valves on heater drain lines etc., the selected thickness shall not be less than:

Sch.40 for pipe sizes above 50 Nb, but below 300 Nb and

Sch. STD for pipe sizes 300 Nb and above.

1.05.00 Layout

All high points in piping system shall be provided with vents. All low points shall be provided with drains. Provisions of drains on steam piping shall be as per ASME code TDP-1. Drain lines shall be adequately sized so as to clear condensate in the line and prevent water hammer and damage to turbine due to water induction. All piping shall be sloped towards the system low point such that slope is maintained in both hot and cold condition.

All drain and vent lines in piping system with design pressure 40 Kg/cm2 (g) and above or with vacuum service shall be double valved.

The pipe routing shall be such that clear headroom of not less than 2.5 metres above the walkways/working area is available. The contractor shall ensure correct orientation of and easy access to valves and instruments etc. and sufficient clearance for removal and maintenance of the same. The piping shall not encroach on withdrawal space of various equipments and walking space.

Wherever there is possibility of ingress of rainwater through floor/ceiling opening at points where any pipe passes through floor/ceiling suitable weather protection hood shall be provided.

1.06.00 Stress / Dynamic Analysis

1.06.01 The contractor as per the requirement of ASME B 31.1 shall carry out flexibility and stress analysis for various piping systems. Analysis results shall satisfy the following.

a. Calculated stresses in the piping system shall be within the allowable limits stipulated in ASME B 31.1 as well as in IBR for the piping under purview of IBR.

b. Calculated forces and moments on equipment nozzles/TP are not more than the allowable loading provided by respective equipment manufacturer(s)/contractors. Flexibility analysis also calculates the deflections in all directions (translational and rotational) to enable design and selection of hanger/support system.

c. Besides the flexibility analysis, steam hammer analysis/dynamic analysis shall also to be performed wherever required to study the effects of fast closure of steam admission valves and safety valve blowing. Requirements of additional restraints/ snubbers to take care of these effects shall be established and the contractor shall provide such restraints/ snubbers. The contractors shall also analyse the effects of seismic & wind loads and provide adequate support to take care of the same

1.06.02 Cold pulling is not permitted. The contractor shall so design the piping systems that there will be no requirement of cold pull for meeting allowable reaction/stress values.

1.07.00 Hangers and Supports

All hangers and supports shall be erected such that they are vertical when the piping is in hot condition (rated parameters). However, in piping system connected to the rotating equipment nozzles, it may be required to design and erect the hangers/supports in the piping near the equipment nozzle as per the requirements/recommendations, if any, of rotating equipment manufacturer (s).

1.08.00 Thermal Insulation

1.08.01 Thermal insulation shall be provided mainly for the following reasons.

a. Conservation of heat and maintenance of temperature as per design cycle.

b. Personnel protection.

1.08.02 Design for personnel protection

For the piping and the equipment with surface operating temperature of 60 degree C and above, the personnel protection insulation shall be applied such that the temperature of protective cladding shall be below 60 degree C.

1.08.03 The Contractor shall prepare an insulation thickness schedule covering both the cases of heat conservation and personnel protection based on following design data.

Design ambient temperature	40 Degree C for inside and 45 Degree C for outside the TG Main plant building.
Maximum cladding temperature	60 Degree C
Wind speed	0.5m/sec. for inside and 0.25m/sec for outside the TG Main plant building
Emissivity of cladding	0.2
Pipe/ Equipment wall temp.	Fluid design temp.
Thickness calculation	As per ASTM C-680 or equivalent

1.09.00	**Flash Tanks**
1.09.01	The flash tanks shall be adequately sized to take care of the total drains in the complete power cycle piping system. There shall be sufficient margin to accommodate the possible variation in drain quantities as well as flash steam. Flash tanks shall be designed as per the requirement of ASME Boiler and Pressure Vessels (B&PV) codes, & ANSI standard. The contractor shall submit design calculation for flash tanks and basis of design parameter selection for Employer's review.
1.09.02	However the minimum design pressure and temperature for the flash tanks shall be 3.5 Kg/cm2 (g) and 210 deg.C respectively. Flash tanks shall also be designed for full vacuum condition.
1.09.03	Corrosion allowance of 3.0 mm shall be added to the design thickness of the shell and head of the vessels. The minimum thickness of the vessels including corrosion allowance shall not be less than 8 mm.
1.09.04	The flash tanks and manifolds shall be designed to take care of the impact forces due to incoming drains.
1.09.05	The temperature in the flash tanks shall be maintained by using condensate/Feed water spray, as the case may be and in whichever case applicable. The spray shall be automatically controlled. However, for flash tanks open to atmosphere continuous spray through an orifice shall also be acceptable.
1.09.06	In case the spray is in manifold, the material for the flash tank manifolds shall conform to ASTM A335 Gr. P22 or better and its thickness shall not be less than SCH 100 of ANSI B36.10 irrespective of temperature of the fluid handled.
1.09.07	In case the spray is in flash tank, it will be preferred that steam does not impinge directly on flash tank. However, if the steam is impinged directly on flash tank, then min. 6mm thick stainless steel plate at steam impingement area shall be provided.
1.10.00	**Specific Requirements - Pipes and Fittings**
1.10.01	Manufacturing tolerances on pipe diameter (for both ID and OD controlled pipes) and thickness shall be as per ASTM A-530/ A999M, as applicable.
1.10.02	Bend thinning allowance shall be provided for all bends as per the recommendations of ASME B 31.1.

1.10.03	Steel pipes and fittings shall in general be provided with butt-welding ends as per ANSI B 16.25. Pipe fittings of size 50 Nb and below shall be socket welded as per ANSI B 16.11. However, in certain cases the preparations of welding end for the pipe may be required to be done to match equipment terminals, valves etc.
1.10.04	All stubs welded to the pipe including welded thermowells and instrument source tappings shall be installed on the pipe prior to stress relieving.
1.10.05	Instrument tubing upto and including the root valves and all line drains & vents shall be generally of the same pipe material as that of the main pipe on which they are located unless & until specified otherwise elsewhere.
1.10.06	Wherever ASTMA 106 Gr. B/Gr. C or A - 105 material are used the maximum carbon content shall be limited to 0.30% (Max.).
1.10.07	Wherever mitered bends are used the thickness of pipe from which they are fabricated shall conform to the requirements of Regulations 361 (C) of IBR. The angle between axes of adjoining pipe sections shall not exceed
1.10.08	Non-destructive examinations, as specified are for butt welds of NPS over 50 mm and for welded branch connections of branch size over 100 mm NPS. For smaller sizes the mandatory minimum requirements shall be as per Table 136.4 of ASME B 31.1 for non IBR piping and as per Regulation 360 of IBR or table 136.4 of ASME B 31.1, whichever is more stringent, for piping under purview of IBR.
2.00.00	**SPECIFIC REQUIREMENTS: VALVES AND SPECIALITIES**
2.01.00	For all globe/ check valves, direction of flow shall be clearly stamped on body of the valve.
2.02.00	All globe valves shall be capable of being closed against the design pressure.
2.03.00	Where globe valve has been specified for regulation purpose, the disc shall be tapered plug type and suitable for controlling throughout its lift.
2.04.00	All gate and globe valves shall have bonnet-back seating arrangement.
2.05.00	Check valves shall have full floating and accurately guided discs.
2.06.00	All gate, globe and check valves shall be designed for reconditioning seating surfaces and replacement of stem and disc without removing the valve body from the line.

2.07.00	Hand wheels for all the valves shall close the valve in clockwise direction when viewed from top. All hand wheels shall be clearly marked indicating direction of opening/ closing.
2.08.00	Manual gear operators shall be provided to open/close the valve against the maximum differential pressure across the valve such that the effort required to operate the valve does not exceed 25 kgf.
2.09.00	Valves of 65 mm Nb & above with rising stem shall be provided with position indicator/ visual indication either through plastic stem covers or through metallic stem covers. All gate, and globe valves of size 50 mm and below in vacuum service shall have extra deep gland packing without requiring water gland sealing. All gate and globe valves of size 65 mm Nb and above in vacuum services shall have adequately deep gland packing and shall be equipped with lantern rings to admit pressurized water for gland sealing.
2.10.00	Where floors and extension spindle arrangements is required for valves, the height of floor stand shall be about one meter from the floor/platform. The floor stand shall be sturdy construction with column, nut plate and hand wheel made of the cast iron conforming to material ASTM-A-126 Grade B. Suitable thrust bearing shall be provided between the hand wheel and floor stand. The connection of the extension spindle to the valve stem shall be through a flexible coupling and shall be designed to permit valve thermal movements. Necessary nuts, bolts etc. for mounting the floor stand on platform shall be provided.
2.10.11	All valves shall be provided with proper name plates indicating complete information.
3.00.00	**INTEGRAL BY PASS VALVES**
3.01.00	The requirement of integral bypass valves shown in P&IDs, is the minimum required. The final requirement shall be worked out, as per process requirement, during detailed engineering.
3.02.00	If integral bypass valve selected is of size 50 mm Nb and below, then gate or globe type of forged construction with socket weld end as per ANSI B-16.11 shall be provided. For integral bypass valves of size 65 mm Nb and above, only cast steel gate valves with butt weld ends as per ANSI B 16.25 shall be provided.
3.03.00	Bypass pipe shall be of seamless construction and thickness corresponding to minimum of schedule 80 and shall be of the same material class as the main pipe.
3.04.00	Integral bypass shall be motor operated if main valve is motor operated.
4.00.00	**SPECIFIC REQUIREMENTS: FABRICATION**
4.01.00	Piping system fabrication shall be in accordance with the requirement of ASME B 31.1. However for system under purview of IBR, the requirements of IBR, shall also be complied with. All dissimilar material piping connections shall be subjected to the

acceptance and approval of the Employer. The contractor in addition to the fulfillment of IBR requirement shall submit complete document.

4.02.00 Where welded pipe and fittings are used the longitudinal weld seams of adjoining sections shall be staggered by 90 deg.

4.03.00 Access holes for radiography at shop for piping requiring 100% radiography shall be provided only if the area to be radio graphed is not accessible from pipe ends. Access holes for field radiography shall be provided.

4.04.00 Bends and Elbows

i) Elbows shall be generally of long radius type.

ii) Bends for piping 65 mm Nb and above shall be made hot and for piping 50 mm Nb and smaller may be made cold.

iii) Bends shall be made in accordance with PFI-ES-24. Bends shall be supplied with the minimum tangents except where the piping layout necessitates shorter lengths in which case the tangents shall be suitably reduced after the bending operation to suit the requirements of the piping layout.

iv) Heat treatment of bends shall be done as per material specification and PFI-ES-6.

v) The finished bends wall thickness at any point of the bend shall not be less than the straight pipe wall thickness. All bends 65 mm Nb and larger shall be ultrasonically examined as per PFI-ES-20.

vi) Where examination of bends indicates that wall thinning has resulted in thickness less than the minimum specified, repair by weld deposition shall be allowed only where the length of the affected area is 150 mm or less as measured along the outside arc of the bend. Repairs in excess of this amount shall not be allowed. All repairs shall be carried out only after approval of the Employer.

vii) Circumferential butt welds shall not be used in the area of the bend. Longitudinal welds, where bends are formed from welded pipe shall be located on the bend's neutral axis.

4.05.00 Branch connections shall conform to the requirements of ASME B 31.1. All branch connection welds shall be full penetration welds, except as permitted by ASME B31.1/ IBR.

4.06.00 All materials that are bent, forged or formed shall be subject to heat treatment after the forming operations as required by the original material specification. For alloy steel materials the preferred heat treatment process is full annealing.

4.07.00 Welding of P1 material to P5 material, as identified in ASTM, shall be avoided by introducing suitable intermediate piece of P4 material.

4.08.00 Cleaning and Protection

i) All fabricated piping shall be cleaned as per relevant SSPC cleaning technique/ practice such that both inside and outside surfaces of the piping are free of sand, loosely adhering scale, dirt and other foreign matters.

ii) After cleaning, outside surface shall be coated with enamel or other protective paint. The weld end preparation shall be coated with deoxyaluminate paint and protected adequately. Use of grease or oil, other than light grade mineral oil is not allowed.

Iii) After descaling, the pipe shall be protected by applying internally with a water soluble preservative.

iv) Following cleaning and preservation, the fabricated sections shall be covered, boxed, capped, or others shielded from further contamination or corrosion.

4.09.00 Marking

i) All piping shall be marked clearly & legibly in the shop with identifying pipeline description and piece no. as per the appropriate component or spool piece fabrication drawing.

ii) Marking shall be by any method that does not produce sharp discontinuities and the marking does not get erased until the piping is erected. Piping 6 mm and thicker may be marked by stamping using round nose or dot interrupted die stamps with minimum nose radius of 0.8 mm.

iii) Items too small to be marked shall have metal tags securely attached to each bundle or container of such items such that it does not get erased until the item has been erected.

5.00.00 SPECIFIC REQUIREMENTS – ERECTION

5.01.00 Where control valves, flow nozzles, orifices and other piping appurtenances are to be installed, they shall be installed only after steam blowing and chemical cleaning

operation. After the completion of the steam blowing/chemical cleaning the contractor shall cut spool pieces of required length and install the components.

5.02.00 Field run piping shall be erected only after completion of erection of all other piping system, structures and equipments unless otherwise approved/directed by the Employer.

5.03.00 When 'C' clamps are tack welded to the pipe for the purpose of alignments of a joint, preheating for the tack welding shall be performed if the main joint adjacent to it to be preheated as per the requirements of this specification, otherwise preheating for the tack weld may be omitted. After the joint is completed, all tack welds shall be removed, flushed with the adjacent surface of pipe by chipping and/or grinding. The areas where 'c' clamps were attached shall be subjected to stress relieving as required.

5.04.00 Hydrostatic test of the piping system shall be done after proper installation of all permanent hangers/supports. Spring hangers shall be locked during hydrostatic test. Prior to steam blowing all hangers that had been locked for the hydrostatic testing shall be unlocked.

5.05.00 Setting and logging of all supports, restraints/ limit stop, spring hangers, etc. is the responsibility of the contractor. Initial setting on all hangers and supports and clearance on restraints and limit stops shall correspond to the design cold values. The Contractor shall check all readings after completion of erection of piping system and application of insulation and carry out readjustment as necessary to be in line with the design cold values. After satisfactory setting of all hangers/ restraints, hanger readings/ clearances shall be logged by the contractor in proper format and a joint protocol be made.

5.06.00 The contractor shall monitor the behavior of all hangers, supports, restraints etc. during the initial stages of plant operation. When the piping system(s) have attained their rated temperature the contractor shall log, hanger readings, snubber deflections, restraints / limits stop clearances, as specified elsewhere.

5.07.00 All gaskets shall be asbestos free material and suitable for the service application.

6.00.00 SPECIFICATION FOR PIPING AND FITTINGS

	Alloy Steel	**Carbon Steel**
A. PIPES		
Material	ASTM A335 Gr.P-91	ASTM 106 Gr. B
	ASTM A335 Gr.P22	ASTM 106 Gr. C
	ASTM A335 Gr.P11	ASTM A 672 Gr. B60

	DIN X20 Cr Mo V 121	CLASS-12/22
	(See Note below)	(See Note below)
Construction	Seamless	Seamless
	(See Note below)	(See Note below)
B. Fittings		
Material for 65	ASTM A234GR. WP91,	ASTM A234 Gr. WPB with
NB & Above	ASTM A234GR. WP22,	A 106 Gr.B piping and
	ASTM A234GR. WP11,	ASTM A234 Gr. WPC for
	X20 Cr. Mo V 121 to DIN 17175	A106 Gr. C piping
	(See Note below)	
Material for 50	ASTM A182 Gr. F91/F22	ASTM A105
NB and Below	ASTM A182 Gr. F11	See note below
	See note below	
c) Basic		
Standards	DIN 17175	ANSI B16.9,
	ANSI B16.9,	ANSI B16.11 &
	ANSI B16.11 &	ANSI B 16.25
	ANSI B 16.25	
d) Construction	Seamless	Seamless
	(Forged for 50 NB & below)	(Forged for 50 NB & below)
e) Rating/ Wall	To match with that of pipe	To match with that of pipe
Thickness		
C. WELDING		
Backing Rings	Not permitted	Not permitted
D. ANALYSIS		
Mandatory	As per DIN 17175 for X-20 material	As per ASME B&PV
Requirements	As per ASME B&PV Sect. II for	Sect.-II.
	ASTM Materials	
Supplementary requirements	For X20 material 1) Product analysis of finished pipe	S1 and S2 for ASTM A106 Gr.C
	as per DIN 17175 Cl. 8.4.2 on two	(one end on 5% of pipe per lot)

	pipes per cast per delivery	
	2)Transverse tension test on the	S2, S4 & S5 for ASTM A105
	end on 5% of pipes per lot as per DIN17175 cl.8.5.2	
	3)For fittings, product analysis and	S1, S2, S4 for ASTM A234 WPC
	transverse tension test as above and 100% MPI	
	For ASTM materials	
	S1 and S2 for pipes (one end on 5% of pipes per lot)	
	S1, S2 & S4 for ASTM A234 pipe fittings	
	S2,S3 & S4 for ASTM A182 fittings	

E. NON DESTRUCTIVE EXAMINATION

Mandatory - As per ASME B31.1 & Regulation 360(d) of IBR

Special requirements –

100% UT/RT & MPI and 3% hardness testing on butt welds of P22, P12, and P11 materials.

100% UT/RT & MPI and 100% hardness testing on butt welds of P91 and X20 materials.

100% MPI on butt-welds of carbon steel materials.

100% UT/RT for fittings of 200NB & above for X20 & P91 material.

100% UT/RT for fittings of all other piping of size OD 508 mm & above.

100% UT/RT for fittings of 200NB & above of boiler feed discharge, recirculation and spray piping of boiler feed system.

F. HYDROSTATIC TEST PRESSURE

(1) Piping system under IBR purview:

At Shop All piping including fabricated piping shall be hydro tested at 1.5 times the design pressure subject to regulation 374 of IBR. However, non-

destructive testing in lieu of hydro test is also acceptable subject to regulation 343 (3) of IBR

After Erection — All piping systems shall be hydro tested at 1.5 times the design pressure subject to regulation of 374 IBR. However, for such systems where it is practically not possible to do hydro tests, the tests as called for in ANSI B31.1& IBR in lieu of hydro test shall also be acceptable.

(2) Non-IBR Piping Systems:-

At Shop — All piping including fabricated piping shall be hydro tested at 1.5 times the design pressure subject to regulation 374 of IBR. However, non-destructive testing in lieu of hydro test is also acceptable subject to regulation 343 (3) of IBR

After Erection — All piping systems shall be hydro tested at 1.5 times the design pressure subject to regulation of 374 IBR. However, for such systems where it is practically not possible to do hydro tests, the tests as called for in ANSI B31.1& IBR in lieu of hydro test shall also be acceptable.

Note:

1. For temperatures above 545 Deg.C, only P91 shall be used
2. EFW Pipes as per ASTM A 672 is acceptable if design pressure & temperature are such that it calls for 150 class piping and size is 550 NB and above. However, fitting shall correspond to ASTM A 234 with Grade compatible with the pipe material.
3. Piping Material for HP Bypass and IP Bypass down stream piping shall be of Alloy steel material to ASTM A 335 Gr. P22/P91
4. Materials for fittings, specialties and valves shall be compatible with piping material.

7.00.00 SPECIFICATION FOR VALVES

7.01.00 Cast Steel Valve (Gate/Globe/Check 65 NB size & above)

Sl. No.	Description	Carbon Steel 600 Lbs & below	Carbon Steel Above 600 Lbs	Alloy Steel 600 Lbs & below	Alloy Steel Above 600 Lbs	Stainless Steel 400 Lbs & below
1.0	**Design standard**			ANSI B16.34		

2.0 Construction

a	Bonnet/Cover	Bolted type	Pressure Seal	Bolted type	Pressure seal	Bolted Type
b	Disc					
	Globe valves	Throttling type plug				
	Check valves	Tilting/swing type				
	Gate valves	Solid/flexible wedge below 100 NB				
		Flexible wedge for 100 NB & above				
c	Seat	Integral type				

3.0 Material

a	Body & Bonnet Cover	ASTM 216 Gr. WCB	ASTM 216 Gr. WCB (Refer note below)	ASTM a217 Gr. C12A ASTM Gr. WC9	ASTM A351 CF8M/CF8
b	Stem	13% Chrome Steel (ASTM-A-182 Gr.F6a)			ASTM 182 F316/ F304
c	Hinge pin (for check valves)	13% chrome steel (ASTM A-182 Gr F6a)			ASTM 182 F316/F304
d	Disc and seat ring (heat treated & hardened)	ASTM A216 Gr. WCB Minimum Hardness 250 BHN	ASTM A216 Gr. WCC (Refer note below) Seating surface hard faced with stellite 350 BHN	ASTM A217 Gr.WC9 ASTM A217 Gr.WC9	ASTM 182 F316/ F304
e	Back seat/ stem guide Bushing	13% Chrome Steel (ASTM-A-182 Gr.F6a) with stellite hard facing			ASTM A182 F316/F304

7.02.00 Forged Steel Valves (50 mm NB & below - Gate/Globe/Check)

S. No.	Description	Carbon Steel	Alloy Steel	Stainless Steel
1.0	Design standard		ANSI B6.34	
2.0	Construction			

	a	Bonnet /cover	Bolted type for 600/ 800 lbsSeal welded type for 900 lbs and above		Seal welded/ Bolted type for 600/ 800 Lbs. Sealed welded above 800lb
	b	Disc:			
		Gate		Solid wedge type	
		Globe		As per manuf. std	
		Check		Piston lift	
	c	Seat		Integral type	
	3.0	Material			
	a	Body & Bonnet Cover	ASTM A-105	ASTM A-182 Gr.F91 ASTM A-182 Gr.F22 ASTM A-182 Gr.F11	ASTM 182 F316/F304
	b	Stem	13% chrome steel (ASTM-A-182 Gr.F6a)		ASTM 182 F316/F304
	c	Disc and seat ring	ASTM A105 hard faced with satellite. Minimum hardness 350 HB	ASTM A182 Gr.F22 hard faced with satellite. Minimum hardness 350 HB	ASTM 182 F316/ F304 Hard faced with Stellite, Minimum hardness 350 HB

7.03.00 **Angle Globe Valve**

	Alloy Steel	**'Carbon steel**
Design Standard	ASME B16.34	ASME B16.34
Material		
Body & Bonnet	A182 Gr.F22 or better	A105 or better
Spindle/ Disc	17% Chrome steel or better	17% Chrome steel or better
Disc Seat	Stellited	Stellited
Body Seat & back seat	Stellited	Stellited
Gland Packing	Graphite	Graphite

Construction

Valve type	Outside Screw & Yoke Type
Body & Bonnet	Forged body with integral /welded bonnet construction
Disc type	Taper plug or Parabolic type to suit system requirement
Pressure rating	To suit the service condition. However, minimum pressure rating shall be corresponding to ANSI Class 1500

7.04.00 Other Valves (65 mm and above)

S. No.	Description	Safety Valve		Relief Valve
		Alloy Steel	**Carbon Steel**	
1.0	Basic standard		ANSI B16.34	
2.0	Pressure Class		400 lbs & below	
3.0	Accumulation		10% (max.)	
4.0	Blow down	4% (max.)		10% to 15%
5.0	Construction			
5.1	General	Spring loaded with weld end inlet, pop up type		Spring loaded with flanged inlet & outlet
5.2	Bonnet		Bolted type	
5.3	Seat bushing	Renewable type screwed on and held in position by pin		
5.4	Shaft seat	-	-	-
6.0	Materials			
6.1	Body & Bonnet / cover	ASTM A 217 Gr. C12A ASTM A-217 WC9		ASTM A216 Gr. WCB / WCC
S. No.	**Description**	**Safety Valve**		**Relief Valve**
		Alloy Steel	**Carbon Steel**	
				ASTM A-217 WC6
6.2	Spindle/ Shaft	Stainless steel (**ASTM A182** F316/F304)		
6.3	Disc, nozzle, seat ring	ASTM A182 F316		

	6.4	Spindle guide	17% chrome steel or monel, heat treated and hardened to minimum hardness 250 HB	
	6.5	Spring	Stainless steel or Tungsten steel	Carbon steel for design temp upto 230 deg.C; Stainless steel for design temp. above 230 deg C

NOTE: The material of body, bonnet/cover & disc shall be compatible to that of pipe material on which the valve is installed

7.05.00 **Specific Requirements**

(i) All valves shall be full port as per ANSI B 16.34.

(ii) Valves of size 65 NB and above shall have butt-welded ends as per ANSI B16.25 and Valves 50 NB and below shall have socket weld ends as per ANSI B16.11.

(iii) Locking arrangement, wherever specified shall be of non-detachable type.

(iv) Valves shall be tested in accordance to ANSI B 16.34

(v) All gate and globe valves shall be with outside screw and yoke with rising stem.

(vi) Gate valves below 100 NB shall be solid wedge/flexible wedge type, valves of size 100 NB and above shall be of flexible wedge type. However, for sizes 100 mm NB and above for temps. above 300^0C, parallel slide valves are also acceptable.

(vii) Specification for valve actuators shall be as indicated in C&I Subsection

(viii Stem for all valves shall be heat treated and hardened - minimum, hardness 200 HB and surface finish of 16 RMS or better in area of stem packing.

(ix) Gland packing for gate and globe valves shall be alloy steel/SS wire reinforced graphite with stem corrosion inhibitor.

(x) All bolts and nuts shall be ASTM A-193 Gr. B 7 and ASTM A-194 Gr. 2H respectively.

(xi) Hand wheels for valves shall be of malleable iron / Carbon steel.

(xii) Minimum differential hardness between seat and other disc material shall be 50 HB in case of 13% chrome hardened with heat treatment of steel.

(xiii) Valve closure test shall be as per ANSI B16.34 and MSS-SP-61. Acceptable maximum seat leakage shall be 2 ml of water per hour per 25 mm of nominal pipe size.

(xiv) Safety and Relief valves shall be supplied complete with discharge elbow and drip pan along with drain.

(xv) For valves of size 65 NB and above in vacuum service, water gland sealing arrangement shall be provided. For valves of size 50 NB and below, deep gland packings shall be provided.

8.00.00 SPECIFICATION FOR HANGERS/ SUPPORTS

8.01.00 Design and Manufacture of Hangers/Supports shall conform to ASME B 31.1, MSS-SP-58, MSS-SP-89.

8.02.00 Where horizontal piping movements exceed 25 mm or hangers rod angularity exceed 4 degrees from cold to hot position, the hanger and structural attachments shall be offset in the cold position in such a manner that the hanger rod is vertical in hot position unless otherwise specified.

8.03.00 The Contractor shall furnish detailed arrangement sketches for each support, restraints, anchor, snubber etc. The sketches shall include the key plan identification no., bill of quantities, design load, operating load, spring stiffness, amount of pre-compression, centre line elevation of pipe, spring box position/orientation, etc.

8.04.00 Hangers support tag no. shall be marked on all pipe hangers/supports, restraints and anchor assemblies. The design loads, hot and/or cold loads shall be stamped on respective constant and variable springs.

8.05.00 Technical Requirements

a. Each threaded connection and adjustable rod shall be provided with lock nuts.

b. Each rod of a double rod hanger support shall be designed for the full hydro test load coming on the double rod hanger assembly.

c. Hanger support rods of less than 10 mm diameter for supporting pipes of 50 Nb and smaller and less than 12 mm diameter for supporting pipes of 65 mm Nb and larger, shall not be used.

d. Parts of the hanger or support which move relative to the pipes during operation shall be connected to the pipe attachments in such a manner that they lie entirely outside the pipe thermal insulation.

e. Attachments to piping shall be as far as possible by clamps.

f. Where axial movement is to be restricted or riser clamps are used, suitable lug stops to prevent pipe movement shall be designed for welding on to pipe.

g. Bolted pipe clamps shall have a minimum thickness of 5 mm for weather protected locations and 6 mm for locations exposed to weather.

h. Beam clamps shall be forged steel equipped with a rod to fix a nut.

i. All sliding surfaces of supports and restraints shall have eflon lining on one surface coming in contact with stainless steel lining on the other surface.

j. All pipes hangers and supports shall be designed to carry the weight of the piping fitting, thermal insulation, self weight of the hanger assembly and medium transported or test medium whichever is heavier. In addition, all rigid rod hangers and variable spring shall be designed to carry the operation load in hot condition.

8.06.00 **Spring Hangers**

a. Constant load hangers shall generally be used when vertical displacement exceeds 40 mm or where the supporting effort variation of available variable spring exceeds 25%.

b. Constant load hanger shall be of moment-coil-spring counter balanced design or cam & spring type. Variable spring hangers shall be of helical spring design. Spring hanger/ assembly shall be constructed such that complete release of piping load is impossible in case of spring mis-alignment or failure.

c. Constant load hanger shall have a minimum field adjustment range of 15% of the load. The total travel for constant load hangers shall be design travel plus 20% but in no case shall the difference between total travel and design travel be less than 15mm. The supporting effort variation throughout the travel range of constant load hangers shall not exceed 5%.

d. Variable spring hangers shall have supporting effort variation of not more than 25% throughout the total travel range.

e. All springs shall remain under compression throughout their operating regime and never under tension.

f. Spring hangers shall have provision for locking the hangers in any position of travel.

g. Spring hangers shall be adjusted to the cold position before shipment and locked in that position. The cold and hot position shall be clearly marked on the travel indicator scales.

h. All spring hangers shall be locked before performing the hydro test. The locking shall be removed before the line is placed under operation.

8.07.00 **Snubbers**

a. Snubbers shall be designed to allow normal movement of pipe due to thermal expansion and shall require minimal maintenance.

b. Snubbers shall be designed to withstand twice the rated load without loss of structural integrity and shall have convenient means for determining rod extension.

c. Snubbers shall be of hydraulic type of Lisega/ITT Grinell, West Germany or Employer approved equivalent.

d. Axes of Snubbers/ restraints shall be parallel to the direction of the expected reaction force in operating condition.

8.08.00 **Restraint & Anchors**

a. All anchors shall be designed for direct rigid fastening to the structural steel member.

b. Anchors, guides and restraints shall be capable of withstanding the forces and moments due to thermal expansion and dynamic effects.

8.09.00 **Testing and Inspection**

a. All shop tests shall be conducted in accordance with ANSI standards and other applicable codes/standards.

b. Each Constant load hanger shall be tested before delivery to ensure that variation in supporting capacity provided through specified range does not exceed 5%.

c. Each variable load spring hangers shall be tested for spring stiffness before delivery.

d. All hangers\ supports\ restraints etc on piping shall be inspected for the conditions mentioned elsewhere in the specification and log reports to be submitted to employer for their review

e. All materials shall be furnished in strict accordance with the applicable codes. All sources of materials shall be disclosed and relevant test certificates giving precise details of identification of material for the physical and chemical properties shall be submitted to the Employer/Project Manager.

9.00.00 **STEAM TRAPS AND STRAINERS**

9.01.00 Steam traps shall be of inverted bucket / thermo-dynamic / thermo static type with integral or separate Y-type strainers.

9.02.00	Traps shall have stainless steel internals and Trap body material shall be compatible with the connecting pipe material as minimum.
9.03.00	All Y-type strainers shall have stainless steel screen of not more than 20 mesh size. Screen open area shall be at least four (4) times the pipe cross sectional area.
9.04.00	Strainers shall have screwed blow off connection with removable plug.
9.05.00	All traps and strainers shall have socket weld ends as per ANSI B 16.11 for size 50 mm Nb and smaller and butt weld ends as per ANSI B 16.25 for sizes 65 mm Nb and larger.
9.06.00	Y-type strainers shall be provided along with each steam trap in case the strainer does not form an integral part of the trap.
10.00.00	**SPECIFICATION FOR THERMAL INSULATION**
10.01.00	**Insulation Materials, Cladding and Accessories**
	The insulating material and cladding material shall be as per the tables of material given in the subsequent clauses.
	All insulating materials, accessories and protective covering shall be non-sulphurous, incombustible, low chloride content, chemically rot proof, non-hygroscopic and shall be guaranteed to withstand continuously and without deterioration the maximum temperature to which they will be subjected under the specification conditions.
	Use of insulation containing asbestos in any form is not permitted.
	Insulation mattress/section shall be supplied in thickness of 25, 40, 50 and 75 mm. Insulation of higher thickness shall be made up in multiple layers using mattress/ slabs of thickness specified above. However, if the required thickness is not achieved, the mattress/slabs in increment of 5 mm shall be acceptable. The min. thickness shall not be less than 25 mm & number of layers shall be min. & the innermost layer shall be thickest.
10.02.00	**Insulation Materials**
	1. Rock/ glass wool insulation mattress shall be of long fibered rock or glass processed into fibrous form bonded with a binder. No Kind of slag wool inclusion is acceptable.

2. Calcium silicate pipe insulation shall be composed principally of hydrous calcium silicate reinforced with mineral fibre, it should be asbestos free.

3. All insulation shall conform to quality requirements specified below and test certificates on samples from the lot to be supplied shall be furnished to employer for approval.

10.03.00 **Others Accessories**

The Contractor shall also provide other accessories such as ceramic boards, sealants and washers as required.

10.04.00 **Installation**

a) All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, rust etc. and shall be dry before the application of insulation.

b) Before applying the insulation the contractor shall check that all instrument tappings, clamps, lugs and other connections on the surface to be insulated have been properly installed as per the relevant erection drawing.

c) All flanged joints shall be insulated only after the final tightening the testing.

d) The insulation shall be applied to all surfaces when they are at ambient temperature. Ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied so as to avoid breaking / telescoping due to alternate periods of expansion and contraction.

All cracks, voids and depressions shall be filled with finishing cement, suitable for the equipment operating temperature so as to form a smooth base for the application of cladding.

10.05.00 **Insulation Materials**

	Type#1	Type#2	Type#3	Type#4	Type#5	Type#6
Type	Lightly resin Bonded min-eral (rock) wool	Lightly resin bonded mine ral (rock) wool	Bonded glass wool	Resin bonded mineral (rock) wool preformed pipe section	Resin bonded glass wool preformed pipe section	Calcium silicate preformed block type
Apperent Density	120-150 Kg/M^3	100 Kg/M^3	64 Kg/M^3	140-150Kg/M^3	60-80Kg/M^3	200-250Kg/m^3
Mtl. Standard	IS:8183	IS:8183	IS:8183	IS:9842	IS:9842	IS:8154
Applicable Service	Piping system & equipment with operating temp. between 400-600 deg.C	Piping system & equipment with operatimg temp. in range of 60-400 deg.C	Piping system & equipment with operating temp. in range of 60-400 deg.C	Piping system of 350 NB and below with temp. in range of 60-650 deg.C	Piping system of 350 NB and below with operating temp. in range of 60-400 deg.C	Piping system & equipment with operating temp. in range of 400-650 deg.C
Testing Requirement	As per IS:8183	As per 8183	As per 8183	As per 8183	As per IS:9842	As per IS:8154

10.06.00 **Cladding Material & Accessories shall be as specified here under**

	Item	Basic Specification	Description
1.	Cladding	Aluminium ASTM B-209-1060 temper H14 or IS:737 Gr.19000/H2	Thickness of sheathing (a) 18SWG (1.219mm) for diameter for insulated surface 450 mm and above and for flat surfaces (b) 20 SWG (0.91 mm) for diameter of insulated surface 150 mm and above upto 450 mm. (c) 22 SWG (0.71 mm) for diameter of insulated surface 150 mm and below.
2.	Binding wire	Galvanised Steel wire to IS:280 for temp. below 400^{O}C and stainless to IS:6528 for temp above 400^{O}C.	20 SWG for all insulation interface temperature
3.	Straps & bands	(i) Aluminium where interface temps are below 400^{0}C. (ii) Stainless steel where temps are above 400^{0}C.	Band shall be 20 mm wide and 0.6 mm thick for securing aluminum Sheathing anodized aluminum bends shall be used.
4.	Screws	Stainless steel	Self tapping, chese headed
5.	Hexagonal wire mesh	(i) Galvanised steel wire to IS:280 mesh for interface temper-ature upto 400 deg. C.	Wire mesh netting shall be 10 to 13 mm aperature at least 0.56 mm diameter wire.

	(ii) Stainless steel wire for temps are above 400 deg. C.
10.07.0	**Insulation on Piping**
10.07.01	All vertical pipes shall be provided with the suitable insulation supports to prevent collapsing/crushing of insulation due to its self weight. Support rings shall be provided on all vertical piping with a difference in elevation of 4 meter or above, and there shall not be more than 3 meter straight length between support rings.
10.07.02	Longitudinal joints of insulation mattresses sections of horizontal piping shall be on the bottom or at the sides of the pipe.
10.07.03	When more than one layer of insulation mattress/section is required on piping the circumferential joints on adjacent layers shall be staggered by at least 150 mm and longitudinal joints shall be staggered by at least 50 mm.
10.07.04	The mattress type insulation shall be formed to fit the pipe and applied with the mattress edges drawn together at the longitudinal joints and secured by lacing wire. Pipe section insulation shall be fitted on pipe using binding wires.
10.07.05	Where insulation is applied in two or more layers each layer of mattress shall be backed with hexagonal wire mesh. For the first layer of insulation and in case of single layer insulation, hexagonal wire mesh shall be provided on both the surface of the mattress. For pipe sections, the sections shall be held in place by binding wires without any wire mesh.
10.07.06	The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the insulation. Any gap in the insulation shall be filled with loose mineral wool or finishing cement.
10.07.07	Insulation mattress/section ends shall be terminated at a sufficient distance from the flanges to facilitate removal of bolts.
10.07.08	The insulation shall be held in place by fastening over with binding wire for insulation surface with diameter unto and including 550 mm and with metal bends for insulation surfaces with diameter over 550 mm. The fastening shall be done at intervals of 250 mm except where specified otherwise. The ends of the binding wires shall be hooked and embedded in the insulation. The straps shall be mechanically stretched and fastened with metallic clamping seals of the same materials as the strap.
10.07.09	Insulation for application on bends and elbows shall be cut into mitred segments, sufficiently short to form a reasonably smooth internal surface. After the application of

insulation material in place, insulating cement shall be applied as required to obtain a smooth surface.

10.07.10 Weather hoods shall be provided for insulated piping passing through floors/walls.

10.07.11 All pipe attachments coming on horizontal pipes, inclined pipes and bends shall be insulated along with pipe such that there will be no insulation applied to hanger rod and the component connecting hanger rod to pipe attachment. All pipe attachments exposed to weather shall be provided with weather proof.

10.07.12 Upstream of all drain lines and the lines connected to steam traps, shall be insulated unto and including first isolating valve for heat conservation. Rest of such lines such as downstream of the drain valves, traps etc. and other lines such as safety valve discharges, vents, etc. shall be insulated for personnel protection.

10.08.00 Insulation on Valves and Fittings

a. All valves fittings and specialties shall be insulated with the same type and thickness of insulation as specified for the connected piping with the special provisions and or exceptions as given below.

b. All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminum sheets of thickness same as the connected pipe cladding. Adjoining pipe insulation shall be beveled back to permit removal bolts and nuts or bands. The portion of the valve which can not be covered by box type insulation shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. The insulation for valves/flanges shall be applied after the finishing has been applied over the connected piping. The cladding shall be applied in such a manner that the bonnet flange can be exposed easily without disturbing the complete insulation and cladding.

Expansion joints, metallic or rubber shall not be insulated unless otherwise specifically indicated.

10.09.00 Insulation on Equipment

a. The insulation applied to the equipment shall be reinforced with hexagonal wire mesh. One layer of wire mesh shall be provided on the equipment surface prior to application of insulation.

b. Installation on horizontal cylindrical vessel/tanks (including heaters, deaerator, heat exchanger etc.).

c. All the surfaces of insulation layers, applied on horizontal cylindrical vessels shall be securely fastened by bands upto vessel/tank outer diameter of 150 mm and below. Where vessel/tank outer diameter exceeds 1500 mm, binding wire passing

through insulation clips provided both longitudinally and circumferentially at 500 mm centres shall be used. Gaps in the insulation shall be filled with loose mineral wool and finished with finishing cement so as to obtain a smooth surface for the application of cladding. The contractor shall provide support ribs/lugs on the surface of the vessel/tank as necessary. The contractor shall obtain the approval of the 'Employer' and the equipment supplier's field engineering representative before performing any welding on equipment. Any heat treatment requirement as per recommendation of equipment supplier shall be performed by the contractor.

d. Installation on Vertical cylindrical Vessel/Tanks (including flash tanks etc.).

e. All vertical vessels/ tanks shall be provided with support rings/ribs with other necessary frame work to take up the weight of the insulation prior to HT. The contractor shall obtain the approval of the 'Employer' and the equipment supplier's field engineering representative before performing any welding on equipment. Any heat treatment of vessel/equipment that is required after welding of rings/ribs on the vessel/equipment shall be as per recommendation of equipment supplier and shall be performed by the contractor.

f. The mattresses shall be held in position by means of 9 SWG steel wire nails, the nails being 25 mm longer than the thickness of insulation to be applied. After the mattresses have been placed over the nails, the nails shall be bent and embedded in the insulation. Alternatively, wire loops may be tack welded at 250 mm centres to hold the insulation in place.

10.10.00 **Installation of Cladding**

10.10.01 All insulation shall be protected by means of an outer covering of aluminium sheathing. All insulation/cladding joints shall be sealed and made effectively weather and water proof. All flat surfaces shall be given suitable slope to prevent collection of pools of water on the cladding surface. All sheathing shall be protected internally by the application of two coats of bitumenastic paint.

10.10.02 All longitudinal joints shall have a minimum overlap of 50 mm and shall be located at 45 deg. or more below the horizontal for horizontal equipment. Joints shall be made with cheese headed self tapping galvanised steel screws at 150 mm centres.

10.10.03 All circumferential joints shall have a minimum overlap of 100 mm and shall be held in position by stainless steel or anodised aluminium bands, stretched and clamped.

10.10.04 Removable box type cladding for valves and flanges shall be fitted on the connected pipe cladding, with bands.

10.10.05 Aluminium cladding shall not come directly into contact with either the equipment surface or with the supporting arrangement on the equipment surface. To this end,

adequate layers of 3 mm thick ceramic board shall be provided between the cladding and any supporting arrangement equipment surface, and fitted with self tapping screws/ metal bands, as applicable.

10.10.06 For bends, fittings etc. the cladding shall be provided in segments as to ensure a smooth finish of the cladding.

10.10.07 For cladding on vertical pipes/equipment, provision for load take up shall be made at every 2 to 4 metres along pipe/equipment axis.

10.10.08 All joints shall be sealed with acrylic emulsion weather barrier.

10.10.09 Galvanic corrosion shall be prevented by carefully avoiding permanent contact of aluminium cladding with copper, copper alloys, tin, lead, nickel or nickel alloys including monel metal.

10.11.00 Testing and Guarantee

a. All tests, as per the applicable material standards and as specified shall be carried out in accordance with the methods prescribed. Employer shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory.

b. The Contractor shall guarantee that if on actual measurement the specified maximum insulation surface temperatures are exceeded, the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.

11.00.00 SPECIFICATION FOR STEAM BLOWING OF PIPING SYSTEMS

11.01.00 Steam blowing shall include engineering, supply and installation of all temporary piping, valves, fittings including quick actuating valves (for puffing purposes), supports, blanking plates, spools, target plates, instruments, controls and all other accessories and services required to complete the cleaning process as specified herein.

11.02.00 The detailed schemes and procedure for steam blowing operations shall be prepared and furnished by the contractor and discussed and finalized during the detailed engineering stage. However, for purposes of bidding, the bidder shall make an estimate based on his experience for the piping system defined below, taking into consideration all temporary piping, consumables etc. required.

11.03.00 Steam blowing shall also include reinstatement of cleaned piping systems; and dismantling/removal of all temporary piping, equipment and materials from site. All temporary piping, valves, equipment and materials shall be taken back by the contractor upon satisfactory completion of cleaning, and shall be removed from the Employer's premises.

11.04.00 Engineering involved regarding temporary piping shall include the following:

a. Selection of temporary piping including disturbance factor calculation.

b. Preparation of layout of temporary piping and performing stress analysis as per ASME B 31.1.

c. Selection of temporary hangers and supports as required.

11.05.00 The following piping systems shall be cleaned through steam blowing operation.

i) Main steam/HP Steam

ii) Hot reheat steam

iii) Cold reheat/ IP super Heat Steam

iv) LP steam

v) HP Bypass, IP Bypass & LP bypass

vi) Complete Auxiliary steam system

vii) Other piping system, if any, as per approved scheme

11.06.00 Steam blowing shall be carried out for removal of particles (rust, scales, weld splatter etc.) from various piping systems to avoid damage to turbine bladings. Cleanliness of system shall be checked by means of test plates made of steel which will be installed in the centre line of the piping system.

11.07.00 Cleaning shall be achieved by steam purging i.e. by blowing of steam through the piping such that the momentum of flow is greater than that of steam flow during normal operation of unit (at MCR). The disturbance factor during steam blowing (ratio of momentum of flow during purge to that during MCR) shall be more than 1.4.

11.08.00 The blow off shall be done with steam, which is exhausted through adequately sized, open ended temporary piping. Temporary piping and motor operated valves shall be installed for steam blowing operation. Pressure shall be built up in the boiler and the piping warmed before release of steam by quick opening of motor operated valve located on temporary piping. The cycle shall be repeated until steam from the blow out pipe is determined to be clean.

If erected already flow nozzles and control valves etc. shall be removed and replaced by spool pieces before steam blowing. The removed flow nozzle and control valves etc. shall be put back after steam blowing.

The motor operated valves used for steam blowing shall have special characteristics like minimum loss of pressure, resistance to wear during grave working conditions (high

velocity and carry over of water and solid particles), quick opening time, minimum effort on electric actuator etc.

11.09.00 The steam blowing termination criteria will be:

(i). Acceptable target plate condition.

(ii). Measured D.F. (disturbance factor) more than 1.4

The required values to calculate actual D.F. will be measured at site. The criteria for acceptable target plate condition shall be finalised during detailed engineering.

12.00.00 SPECIFICATION FOR CHEMICAL CLEANING OF PIPING SYSTEMS AND EQUIPMENTS

12.01.00 It is intended to chemically clean the following piping systemn thickness at no extra cost.

(a.) Boiler feed piping

(c.) Main condensate piping

(d.) The following equipment which form a part of the above system shall also be included in the cleaning operation.

(i.) Deaerator

(ii.) Gland steam cooler

(iii) Any other piping /equipment as per agreed scheme

12.02.00 Before introducing chemicals, all the piping systems and equipment listed above shall be water flushed. Alkaline cleaning acid cleaning and passivation will follow water flushing.

12.03.00 However, the Bidder shall submit along with the offer his usual procedures and practices for chemical cleaning of the piping and equipment specified. The Bidder shall submit all schematics, write up, details of chemicals to be used etc. and detailed procedures he intends to follow. These schematics and procedures shall be subject to the approval of the Employer.

12.04.00 Pre-Cleaning Procedure

Prior to starting any phase of cleaning operation the following procedures shall be ensured.

i) Installation of all temporary piping, valves, pumps and equipments as required for the flushing and chemical cleaning operations.

ii) Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement/vibration beyond acceptable limits.

iii) Installation of the instruments as required to ensure satisfactory monitoring and control of the cleaning process. The Contractor shall also determine and arrange

	locations for sampling of the cleaning solution during cleaning. iv) Bypassing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces. v) Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. Pump internals shall not be installed. vi) Installation of plastic seal in the condenser neck to protect the turbine from alkaline fumes. vii) Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation. viii) Hand cleaning of the interiors of all vessels which are included in the cleaning operation.
12.05.00	**General Cleaning Procedures**
12.02.00	Before introducing chemicals, all the piping systems and equipment listed above shall be water flushed. Alkaline cleaning acid cleaning and passivation will follow water flushing.
12.03.00	However, the Bidder shall submit along with the offer his usual procedures and practices for chemical cleaning of the piping and equipment specified. The Bidder shall submit all schematics, write up, details of chemicals to be used etc. and detailed procedures he intends to follow. These schematics and procedures shall be subject to the approval of the Employer.
13.00.00	**SPECIFICATION FOR FLASH TANKS**
13.01.00	The flash tanks and accessories shall be designed, manufactured and tested in accordance with ASME Boiler and pressure vessels (B&PV) codes (latest) and other applicable ANSI standards referenced in the above codes.
13.02.00	Number and Sizing
13.02.01	Flash tanks shall be provided into which all-recoverable drains from turbine casing, valves, strainers, HP steam, CRH and HRH line drains, etc. shall be led. Number of flash tanks shall as per tender drg. Requirement /details of various flash tanks are given below:
13.02.02	High pressure (HP) flash tank for accommodating high-pressure steam drains as indicated in the tender drawing.
13.02.03	Low pressure (LP) flash tank for accommodating low pressure (below hot reheat design pressure) steam drains as indicated in the tender drawing.
13.02.04	Atmospheric flash tank to accommodate alternate drains of steam lines, feed water safety valve discharge and aux. steam line drains, as indicated in the tender drawing.
13.03.00	Constructional Features

13.03.01 Flash tanks shall be vertical, cylindrical design and of welded construction with torispherical or hemispherical heads.

13.03.02 Drain/hot water inlet nozzles shall be tangential to the vessel periphery. Suitable vortex breaker arrangement shall be made at the liquid outlet to the vessel. In case the contractor finds better alternate arrangement, the same can be submitted for the Employer acceptance & approval.

13.03.03 The drain and vent of the flash tanks shall be adequately sized and lead to the condenser. There shall not be any valve on the drain and vent lines. Loop seal shall be provided on drain if required.

13.03.04 A manhole shall be provided on the flash tanks for inspection purpose. It shall be of diameter 500 mm minimum. The manhole shall be of devit type and shall be provided with grip.

13.03.05 The flash tanks shall be located on the ground/mezzanine floor of the powerhouse. Necessary structural supports including anchor bolts shall be provided. Three (3) support legs at 120 degree spacing shall be provided for supporting the flash tanks. Necessary lifting lugs for handling the tanks shall be provided.

13.03.06 The flash tanks shall be provided with a full-length level indicating gauge glass complete with protective rods, isolation valves and drains. Temperature indicators and temperature switches shall be provided on the flash tanks.

13.03.07 The flash tanks shall be provided with access ladders, if required for access to the instruments, valves, main holes etc

13.04.00 Schedule of Materials

Shell and Head	ASTM A 285 Gr.C
Wear Plate/Baffle	ASTM A 285 Gr.C
Nozzle Neck	ASTM A 106 Gr.B
Manhole nozzle flange and cover	ASTM A 285 Gr.C
Couplings	ASTM A 105
Bolts and studs	ASTM A 193 Gr. B7
Nuts	ASTM A 194 Gr. 2 H
Gaskets	Spiral wound SS 316 with graphite

However the material as per ASTM A 516 Gr. 60 or IS 2062 Gr. B shall also be acceptable subject to the relevant codes / standards permitting so for the design parameters of various flash tanks.

14.00.00 **SPECIFICATION FOR METALLIC EXPANSION JOINTS**

14.01.00 The expansion joints shall be of metallic multi-bellows construction and shall be used to reduce the reactions (forces and moments) at the connected equipment terminals due to thermal expansion/connection and/or vibration of connected equipment and piping.

14.02.00 The design, material, construction, manufacture, inspection, testing and performance of the expansion joints shall comply with the currently applicable requirement of EJMA, Boiler and Pressure Vessel Code Section III, ANSI B-31.1 and all statutes, regulations and safety codes.

14.03.00 Construction Details

14.03.01 Bellows

i. The bellow shall be hydraulically or roll formed from perfect cylinders of single ply, 304 grade stainless steel.

ii. Number of longitudinal weld seams shall be minimum and there shall be no circumferential weld seam.

iii. Cold formed stainless steel bellows shall not be heat treated.

iv. All bellow elements shall be pickled after forming.

v. Equalizing rings, where required, shall be either from high quality castings of from fabricated metal.

vi. Flanged expansion joints shall be provided with adequate pipe stubs.

Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the joints efficiency.

14.03.02 Sleeves

i. Expansion joints will be furnished with internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection. The sleeves shall be welded on the flow inlet end of the joint only.

ii. Bellow shall have external sleeves with an arrow indicating the direction of flow on the outside. The external steel covers provided to protect bellows from physical damages, shall be suitable for supporting insulation where necessary and shall be detachable.

14.03.03 Tie Bars

i. Joints shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie bars to prevent damage and misalignment during transit and also with permanent tie bars along with necessary nuts, bolts etc.

ii. The rods on pressure balanced type expansion joints shall be adequately sized to prevent buckling in vacuum services or services with other external loads.

14.04.00 **Type test of Metallic Expansion joints**

Following tests (Type tests) shall be carried out for metallic expansion joints as per the procedures given in EJMA.

a) Life Cycle Test

b) Meridional yield-rupture testing

c) Squirm testing

14.04.01 For the purpose of carrying out type tests; metallic bellows shall be grouped based on the parameters as given below. The bellows conforming to same combination of these parameters shall constitute one group. Type test shall be carried out on one or more bellows (as required) for the successful completion of all the type tests specified above.

i. Material of bellow: Based on material of bellow, bellows shall be categorized into three category namely Carbon steel, stainless steel (Eg. SS304, 316, 321etc.) & High alloy steel (Eg. Inconel).

ii. Profile of convolutions: Each profile shall be considered as separate category (e.g. U profile, V profile & Lyra profile etc.).

iii. Dimension of bellows: Based on the size, the categories shall be as under:

§ Nominal diameter of metallic expansion joint up to and including 800mm NB.

§ Nominal diameter of metallic expansion joint greater than 800mm NB up to & including 1600 NB.

§ Each size above 1600mm NB shall be a separate category.

iv. Design pressure: Based on the design pressure, bellows shall be categorized as under:

§ Design pressure from full vacuum up to 5 kg / sq.cm (g).

§ Design pressure above 5 kg / sq.cm (g) and up to 10 kg / sq.cm (g) with or without vacuum.

14.04.02 **Number of cycles**

For the life cycle test, the number of test cycles shall be minimum 10,000 cycles.

14.04.03 Other tests for metallic expansion joints shall be carried out as per the approved QP / QA Section. Further, other terms and conditions for type test shall be as specified elsewhere in the specification.

15.00.00 L.P.CHEMICAL DOSING SYSTEM

15.01.00 Tanks

Vertical and cylindrical design with dished/ conical ends, SS-304 material of construction, shell thickness 3 mm for the tanks as per details given below:

	Ammonia metering measuring tank	**Ammonia mixing storage tank**	**Hydrazine metering/ measuring tank**	**Hydrazine storage tank**
Storage Capacity (in litres)	**125**	**2300**	**30**	**2300**
Nos.	1 no./skid	1 no./skid	1 no./skid	1 no./skid

Note: 1. Concentration of aqueous ammonia solution shall be 29.4%.

2. Concentration of hydrazine solution shall be 35%

15.02.00 Transfer pumps

Item Description	**Ammonia pump**	**Hydrazine pump**
Material (Pump internals in contact with chemicals)	SS-304	SS-304
Capacity	to suit requirement	to suit requirement
Nos.required	1 no. (1x100%) per STG	1 no. (1x100%) per STG
Concentration	30% concentration	35% concentration
Type of pump	Hand pump	Hand pump

15.03.00 **Metering/ Dosing pumps**

Item description	Ammonia	Hydrazine
Capacity (lph)	0-50	0-50
Nos.	2x100% per unit	2x100% per unit
Rated discharge pressure (Kg/cm^2) (g)	45(Kg/cm^2) (g)	45(Kg/cm^2) (g)
Type	Reciprocating	Reciprocating
Material (Pump internals in contact with chemicals)		SS-304 S S - 3 0 4

15.04.00 **Chemical to be handled**

	Ammonia	Hydrazine
Normal	30% conc. ammonia solution	0.6% conc. hydrazine solution
Wet laying	15% conc. ammonia solution	35% conc. hydrazine solution

15.05.00 **Material for Piping**

	AMMONIA	HYDRAZINE
PIPING	SS 304 / 316	SS 304 / 316
FITTINGS	A182 GR.F304/316	A182 GR.F304 /316
VALVES	A182 GR.F304/316	A182 GR.F304 /316
END CONNECTION	SW/ ANSI B16.11	SW/ ANSI B16.11

15.06.00 Each Steam Turbine Generator (STG) shall be provided with a skid of hydrazine & ammonia dosing comprising of metering pumps (2x100%), strainer (2x100%), piping, valves, instrumentation etc. for both normal operation dosing as well as dosing required for wet laying of boiler The capacity of tanks and parameters of pumps given are indicative & minimum. Final parameters shall be as per system requirements.

Note: Capacity of various tanks and pumps are tentative. It is contractor's responsibility to design/size these tanks and pumps depending upon system requirement/design and submits the same to Employer for approval

15.07.00 Control and Instrumentation Requirements

(a) The bidder shall supply all necessary Instrumentation for satisfactory operation of dosing system. The control of the system shall be through BOP C&I part of DDCMIS.

(b) The bidder shall supply all field instruments, devices as per the approved schemes as a minimum. These field instruments should confirm to requirements specified in the control and instrumentation section of this volume.

(c) It is intended to control dosing system from BOP C&I part of DDCMIS , including ON/OFF command of individual pumps. However Bidder shall provide local pre-wired control panel complete with i) Start/stop push buttons ii) Indicating lamps iii) Local/Remote selection iv) Stroke position indicator v) Rise/Lower push buttons for sroke position vi) Local LED based annunciation driven by BOP C&I part of DDCMIS vii) Stroke position indicator on the panel.

(d) The normal mode of operation of dosing system shall be through BOP C&I part of DDCMIS. Local/Remote selection is to be done from Remote (CR) and indication for the same is to be provided on local panel.

(e) The ON/OFF commands for individual pumps from local push buttons shall act on the respective drives through BOP C&I part of DDCMIS.

(f) The stroke position and adjustment will be done by 4-20 mA D.C. signal from BOP C&I part of DDCMIS and the pumps stroke actuation should be suitable for accepting 4-20 mA D.C. signal. The pumps are to be provided with 24 V DC, two wire LVDT type position feed back transmitter which will generate 4-20 mA signal indicating stroke position

16.00.00 SPECIFICATION FOR SURFACE PREPARATION & PAINTING

16.01.00 Surface preparation methods shall be of the type specified herein. If the contractor desires to use any paint/ primer material other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.

All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labeled by the manufacturer with the manufacturer's name, type of paint, batch number and Colour.

Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel / aluminum/ hastelloy /lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.

All pipelines shall be Colour coded for identification as per the Employer Colour-coding scheme, which will be furnished to the contractor during detailed engineering.

16.02.00 **Surface Preparation**

All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.

The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.

SP1 Solvent cleaning
SP2 Application of rust converter (Ruskil or equivalent grade)
SP3 Power tool cleaning
SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)
SP4 A Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 5-0 microns
SP5 Phosphating
SP6 Emery sheet cleaning/Manual wire brush cleaning.

16.03.00 **Application of Primer / Paint**

The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.

Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.

Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.

Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.

Following are the Primer/painting schemes envisaged herein:

PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.
PS4 - Synthetic Enamel (long oil alkyd) to IS2932.
PS5 - Red oxide zinc phosphate to IS-12744.

PS9 - Aluminum paint to IS 2339.
PS9A - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature above 400 °C) and to IS-13183 Gr.-II (for temperature 200 °C - 400 °C)
PS13 - Rust preventive fluid by spray, dip or brush.
PS14 - weldable primer-Deoxaluminate or equivalent.
PS16 - High Build Epoxy CDC mastic '15' .
PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.)
PS18 - Epoxy based TiO2 pigmented coat
PS19 - Epoxy based Zinc phosphate primer (92% zinc in dry film (min.), %VS=40.0(min.)
PS20 - Epoxy based finish paint.

All weld edge preparation for site welding shall be applied with one coat of weldable primer.

For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

16.04.00 **Primer/ Painting Schedule**

Shall be as per Annexure-1

17.00.00 **Testing Requirements:**

The detailed testing requirements for power cycle piping and its components are given in the subsection for Quality Assurance(QA) .The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.

1.01.01 Primer/Painting Schedule

Annexure-1

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade
				System	Coat	Min. DFT / coat (Microns)	System	Coat	Min. DFT/ Coat (Microns)	System	Coat	Min. DFT/ Coat (Microns)		
1.	**All insulated Pipings**, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS 5	2	25	-	-	-	PS 4	1	25	75	As per PPCL Colour shade/ coding scheme
2.	**All un-insulated Piping,** fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature <95 °C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 $	35 $	155 $	
		Design temperature 95 °C-200 °C	SP3/SP4	PS 9	1	20				PS 9	1	20	40	
		Design temperature > 200 °C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load **Hanger** (CLH), Variable Load Hanger (VLH) and other supports		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	
4.	**Valves**													
	Cast	Design temperature <95 °C	SP1/SP2/ SP3	PS4/PS9	1	40	Polyamid Epoxy	1	100	PS 17	1	40	180	
		Design temperature 95 °C-200 °C	SP1/SP2/ SP3	PS9	1	20	-	-	-	PS9	1	20	40	
		Design temperature > 200 °C	SP1/SP2/ SP3	PS9*	1	20				PS9*	1	20	40	
	Forged	Design temperature <95 °C	SP1 & SP5	PS13/ Phenolic fortified alkyd	1	40	Polyamid Epoxy	1	100	PS17	1	40	180	
		Design temperature 95 °C-200 °C	SP1 & SP5	PS9	1	20	-	-	-	PS9	1	20	40	
		Design temperature > 200 °C	SP1 & SP5	PS9*	1	20				PS9*	1	20	40	

5.	Weld Edges	SP6 (Hand cleaning by wire bursching)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	-	

$ The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3rd finish coat (min.DFT 35 Microns) shall be applied at site.

Note :- Structural steel components shall be painted as per the chapter "Painting" in Part-B,Volume-I, Mechnical.

Clause No.	LOW PRESSURE PIPING SYSTEM (M5)

1.00.00 **EQUIPMENT SIZING CRITERIA**

1.01.00 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

1.02.00 For all L.P. piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

1.03.00 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

(a) Water Application

Water Velocity in m/sec

	Pipe Size	Below 50 mm	50-150 mm	200 mm & above
(i)	Pump suction	------	1.2-1.5	1.2-1.8
(ii)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
(iii)	Header	------	1.5-2.4	2.1-2.4

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:

(i)	Carbon steel pipe	100
(ii)	C.I Pipe/ Ductile Iron	100
(iii)	Rubberlined steel pipe	120
(iv)	Stainless steel pipe	100

For calculating the required pump head for pump selection , atleast 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.

(b) Compressed Air Application

Compressed air Velocity 6.0 - m/sec.

1.04.00 The pipes shall be sized for the worst (i.e. maximum flow, temperature. and pressure values) operating conditions.

1.05.00 Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.

1.06.00 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.

1.07.00 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.

1.08.00 All high points in piping system shall be provided with vents alongwith valves. All low points shall be provided with drains alongwith valves. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.

1.09.00 Material of construction for pipes carrying various fluids shall be as specified elsewhere.

1.10.00 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.

1.11.00 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before despatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.

1.12.00 Threaded joints shall be provided with Teflon sealant tapes.

1.13.00 Following types of valves shall be used for the system/service indicated.

SYSTEM	TYPES OF VALVES				
	Butterfly	Gate	Globe	Check	Ball	Plug
Water	x	x	x	x	x	
Air		x	x	x	x	
Drains & vents		x	x	x		
Fuel oil (if any)		x	x	x	x	x

1.14.00 Recirculation pipes alongwith valves, break-down orificies etc. shall be provided for important pumping systems as indicated in respective processs and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

2.00.00 TECHNICAL SPECIFICATION

2.01.00 GENERAL

Specific technical requirements of low pressure piping, fittings, supports, valves, specialities and tanks etc. have been covered under this Sub-section. It in-

cludes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on overground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialities, piping hangers / supports, tanks etc.

2.02.00 Pipes and fittings

2.02.01 All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP equipment sizing criteria.

2.02.02 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.

2.02.03 Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localised bending stresses.

2.02.04 Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).

2.02.05 Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.

2.02.06 The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.

2.02.07 Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.

2.02.08 For rubber lined ERW pipes, beads shall be removed.

2.02.09 Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.

2.02.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.

2.02.11 For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.

2.03.00 Material

2.03.01 Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.

2.03.02 No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.

2.03.03 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.

2.03.04 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.

1.Raw water, circulating water, aux. cooling water, clarified water, service water, HRSG wash water, clarifier sludge and equipment cooling water including both primary & secondary circuit (DMCW, pH-corrected & ACW) drain (DMCW, pH-corrected & ACW), drain water. storm water, treated ettuient disposal.	IS-2062 Gr. B/ASTM A-36/ASTM A-53 type 'E' Gr.B / IS-3589 Gr. 410 /IS-1239 Heavy. For equipment cooling water system wherever DM water is used or alkaline solution is used for pipes 50NB and below, pipe material shall be shall be stainless steel to ASTM A312 Gr. 304 sch. 40 Seamless.
2.Demineralised water, (condenser makeup water, Boiler fill and Deaerator	Stainless steel to ASTM A-312, Gr.304 welded for sizes above 50 mm NB

Fill water, equipment cooling water pipingfrom overhead tank to suction headerof DMCW pumps and chemical dosingsystem to primary circuit of equipmentcooling water (DMCW System), ECW overhead tank make-up water,Filterd water.	Stainless steel to ASTM A312, Gr. 304 sch. 40 Seamless for sizes 50mm and below.
3.Drinking water time	ASTM A-53 type E Gr. B galvanised/ IS 1239 heavy galvanised/IS 3589 Gr 410 galvanised to IS- 4736 or equivalent.
4.Instrument air & plant air	ASTM A-53 type E Gr. B galvanised/ IS 1239 heavy galvanised/IS 3589 Gr 410 galvanised to IS- 4736 or equivalent.
5.Condensate spill water/ Deaerator Drain	ASTM A 106 Gr. B
6.Oil piping	API 5L
7. Acidic Water	Rubber lined steeli
8. Conc. Hydrochloric Acid (5 - 30 %)	MSRL
9. DIlute Hydrochloric Acid (Less than 5%)	Rubber lined steel
10. Acid (Sulfuric) a) Strong (Conc.) b) Diute (upto 10%)	 M.S. Teflon lined steel
11. Alkali (Sodium Hydroxide) a) Strong (5% & above) b) Dilute (below 5%)	 Stainless Steel Rubber lined steel/stainless steel
12. Alum Solution	Rubber lined steel
13. Lime slurry/solution/ Suspensins	Galvanised steel
14. Coagulant aid solution	Rubber lined Steel
15. Liquid and Gas Chlorine (Under Pressure)	Seamless Carbon Steel Schedule 80 (Heavey Duty)

16. Chlorinated Water	Rubber lined steel for above ground & HDPE pipe for below ground
17. Wet chlorine gas (under vacuum)	MSRL
18. Sludge (From clarifier)	Cast Iron (class A as per IS: 1536) / Ductile Iron
19. Excharger Backwash water & Waste effluent from DM plant vessels & chemical solution tank's etc.	Rubber lined Steel for above ground pipe &

2.03.06 In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A 53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.

2.03.07 Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).

2.03.08 In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.

Bidder/ Contractor shall note that stainless steel pipe offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.

2.03.09 Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS:1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanised to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS:3589, Gr. 410 / IS:1239 Gr. Heavy.

	The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanised).
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained
2.04.00	**Piping layout**
2.04.01	Piping shall be grouped together where practicable and routed to present a neat appearance.
2.04.02	Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.
2.04.03	Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8M above roadways/railways. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
2.04.04	Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Employer to the installation of the field run pipe work.
2.04.05	All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc. Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
2.04.06	Piping shall generally be routed above ground but where specifically indicated/approved by the Employer the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.
2.04.07	Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialities.

2.04.08 All local instruments shall be located on pipe lines as to render them observable from the nearest available platforms.

2.04.09 Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.

2.05.00 **Slope/ Drains and Vents**

2.05.01 Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. In addition to the system requirement all low points in the pipelines shall be provided with suitable draining arrangement and all high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size upto 150mm, not less than 20mm upto 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes.

2.05.02 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

2.06.00 **Pipe Joints**

In general all water lines 65mm nb and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

2.06.01 **Screwed**

(a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS:554 unless specified otherwise.

(b) Galvanised pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanised pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw &

socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanised, or in case match pipes and fittings are already galvanised before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, alongwith the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 150 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydrotest.

(c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.

(d) For pipe sizes from 350 mm NB to 550 mm nb (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanised. Any site welding done on galvanised pipes shall be done with zinc-rich special electrodes and the welded sufaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydrotesting.

(e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/ blind flange, or, equipment connection where application of zinc-silicate paste after wleding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

2.06.02 **Welded**

(a) For making up welded joints (butt weld or socket weld) the welding shall be

performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

2.06.03 **Flanged**

(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/ traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.

(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.

(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

2.07.00 **Bends/ Elbows/ Mitre bends/ Tees/ Reducers & other fittings**

2.07.01 Unless otherwise specified elbows shall be of long radius type.

2.07.02 For pipe sizes upto 65Nb, long radius forged elbows or seamless pipe bends shall be used. Pipe bends, if used, shall be cold bent to a radius measured to the centre line of pipe of 3 to 5 times the pipe diameter.

2.07.03 For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.

2.07.04 Mitre bends are not acceptable in case of rubber lined mild steel pipes.

2.07.05 For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 Gr. WPB up to 300 NB. For pipe reducers and tees above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9.

However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.

For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-

C-208.

2.07.06 Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 or ASTM-A-403, Gr. WP 304 Class-S, for sizes upto and including 50mm NB, i.e., the fitting shall be of seamless construction. However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304, Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.

2.07.07 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

2.08.00 Flanges

2.08.01 Flanges shall be slip on type. Welding of flanges in tension is not permitted.,

2.08.02 All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/ temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent.

2.09.00 Specific technical requirement of laying buried pipe with anti corrosive treatment

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) metre below finished general ground level.

2.09.01 **Trenching**

(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822.

(b) Free 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.

(c) The free working space shall conform to IS:5822. The trench shall be excavated so as to provide minimum cover of 1000mm between the top of the pipe and finished grade.

(d) Prior to lowering and laying pipe in any trench, the Bidder shall backfill and compact the bottom of the trench or excavation in accordance with IS:5822 to provide an acceptable bed for placing the pipe.

(e) Coating and Wrapping shall be done as under

2.09.02 **Preparation and cleaning of piping**

(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, moisture, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting,power tool cleaning,etc.. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.

(b) Certain inaccessible portions of the pipeline(which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.

(c) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230mm for joints, which shall be coated manually at site after laying, welding and testing the pipe.

(d) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied as found suitable for systems handling other than corrosive water or fluid.

2.09.03 **Coating and wrapping**

(a) Burried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

(1) Coating primer (coal tar primer)

(2) Coating enamel (coal tar enamel)

(3) Wrapping materials.

(b) All primer/coating/wrapping materials and methods of application shall conform to IS:10221 except asphalt/bitumen material. Materials (primer/coating/ wrapping) as per AWWA-C-203 are also acceptable.

(c) Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fibre, tissue inner wrap followed by glass fibre or coal tar impregnated kraft outer wrap or finish coat.

(d) Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of coats and wraps shall be decided based on soil corrosivity / resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

(e) Total thickness of completed coating shall not be less than 4.0 mm.

(f) Alternatively, the anti-corrosive protection can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to AWWA-C-203. These-tapes shall be applied hot over the cold coal tar primer. The total thickness of the finished protective coating shall be 4.0 mm minimum.

2.09.04 **Trench bed preparation and back filling**

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS:5822.

2.09.05 **Laying of galvanised steel (GI) pipes**

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of burried piping" and " anti corrosive protection for burried piping" are applicable for burried galvanised steel (GI) pipes also.

2.10.00 **Cleaning and flushing**

2.10.01 All piping shall, be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.

2.10.02 Before erection all pipework, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanised pipes shall be done in such a manner that the coating on MS pipe is not affected.

2.10.03 After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.

2.10.04 All compressed air pipe work shall be cleaned by blowing compressed air.

2.11.00 **Surface preparation and painting**

Pipes shall be cleaned both internally and externally thoroughly by blast-cleaning or power tool cleaning method as indicated above. In case of oil piping, cleaning will have to be done by pickling. No painting is required on galvanized pipe surface or galvanized steel surface. However, necessary colour banding for identification as per colour code shall be done. External surface of piping shall be cleaned and prepared as indicated

below.

2.11.01 **Primer painting**

(a) After the surface is prepared two coats of red oxide (zinc chromate) primer conforming to IS-2074 or equivalent shall be applied. Primer shall be applied by brushing to ensure a continuous film without holidays. Primer coat shall be immediately applied without any time lag after the surface preparation.

(b) 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 a touch up coat of primer wherever the shop coat has been abraded, removed or damaged during transit/erection, or defaced during welding.

2.11.02 **Finish painting**

(a) Paint to be used shall be synthetic enamel paint conforming to IS-2932 or equivalent. Finish painting shall be carried out in three coats consisting of one intermedate coat and two finishing coats. Dry film thickness (DFT) of painting inclusive of primer thickness shall be at least 150 micron.

(b) The primed surface shall be cleaned of dust/dirt/grease etc. without scratching or in any way damaging the primer coat. The intermediate coat shall be allowed to dry before applying the finish coat or as recommended by paint manufacturer.

(c) Paint shall be applied by brushing. It shall be ensured that brush marks are a minimum and the requirements of workmanship is as specified in IS-1477.

(d) Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted.

(e) No painting shall be done in frost/foggy weather or when the humidity is high to cause-condensation on the surface to be painted.

2.11.03 **Other requirements**

(a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.

(b) The colour of the finish paint shall be as per approved colour coding.

(c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.

(d) The dry film thickness of paint shall not be less than 0.15 mm.

2.11.04	Colour code for identification The pipes shall be colour painted/banded for identification as per the approved colour coding scheme and shall be generally as per IS-9404.
2.12.00	**Specification for hangers and supports**
2.12.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.
2.12.02	While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.
2.12.03	Hanger for piping 65mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
2.12.04	Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS:2062/IS:226/or equivalent. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. The structural steel work shall be as per IS:800/BS:4360. Insulation protection saddles shall be used at support point of all insulated piping.
2.12.05	The support shall be so interspaced as to minimise sagging of the pipes and to keep them with in permissible limits where pipes are full with the conveying media.
2.12.06	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
2.12.07	All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
2.12.08	At all sliding surfaces of supports suitable arrangement is to be provided to minimise sliding friction.
2.12.09	All components of hangers/supports shall be provided with two coats of primer (red oxide paint) at shop before despatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS:2932 of toal DFT 100 to 140 microns. CLH & VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.
2.13.00	**Design/ Construction/ Material Particulars of Gate/ Globe/ Check Valves/ Globe Stop Valve/ Butterfly valve**
2.13.01	**GENERAL**

(a) All valves shall be suitable for the service conditions i.e flow, temperature and pressure, at which they are required to operate.

(b) The valves as well as all accessories shall be designed for easy disassembly and maintenance.

(c) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.

(d) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type.

(e) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the handwheel. In case where the handwheel is not directly attached to the valve spindle suitable gearing shall be introduced.

(f) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.

(g) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350mm and above either bevel or spur gearing shall be provided to facilitate manual operation.

(h) The valves coming in vacuum lines shall be of extended gland type and/or water sealed.

(i) The actuator-operated valves shall be designed on the basis of the following:

(1) The internal parts shall be suitable to support the pressure caused by the actuators;

(2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

(3) All actuator operated valves shall be provided with hand operated gearing mechanism also.

(4) All actuators operated valves shall open/ close fully within time required by the process but not later than 60 seconds after actuators starts.

(j) Valves coming under the purview of IBR shall meet IBR requirements.

(k) Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items :

(1) Hand wheel

(2) Position indicator (for above 50 mm NB valve size)

(3) Bypass valves and gear operators for valves of size 350 NB & above.

(4) Draining arrangement wherever required.

(l) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.

(m) Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB

(n) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.

(o) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.

(p) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

(q) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by Employer so that they can be operated with ease from the nearest operating floor. Wherever, necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to the Employer.

(r) All valves except those with rising stems, shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.

(s) For Cl gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.

2.13.02 **VALVE BODY MATERIAL**

Valve body material for various services shall be as follows:

Valve body material for non-sea water application like Raw water, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65NB and above ; gun-metal for sizes 50 Nb and below.

For compressed air application, valve material shall be galvanised cast carbon steel or forged carbon steel per sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water : SS body and disc alongwith SS internals.

Condensate : Cast Carbon Steel / Forged Carbon Steel.

2.13.03 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

Standards and Codes

AWWA-C-504	-	Rubber seated butterfly valves.
BS-5155/EN-593	-	Cast iron and carbon steel butterfly valves for general purpose.
IS-778	-	Gun-metal gate, globe and check valves for general purpose.
BS-5154	-	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	-	Sluice valves for water works purpose (50-300 mm size)
IS-2906	-	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	-	Cast iron wedge and double disc gate for general purpose.
BS-5152	-	Specification for cast iron globe valves.
BS-5153	-	Cast iron check valves for general purpose.
IS-5312	-	Swing check type reflux (non-return) valves.
ANSI B 16.34	-	Standard for valves.
API-594	-	Standard for Dual-check valves.
API-600	-	Steel gate valves.
ANSI-B-16.10	-	Valves face to face and other relevant dimension.

API-598 - Valves inspection test.

2.13.04 **End Connections**

The end connections, shall comply with the following:

Socket welding (SW)	-	ANSI B 16.11
Butt Welding (BW)	-	ANSI B 16.25.
Threaded (SC)	-	ANSI B 2.1
Flanged (FL)	-	ANSI B 16.5& AWWA-C-207(steel flanges), ANSI B 16.1 (Cast Iron flanges)

2.13.05 All cast iron valves (gate, globe and nonreturn)i shall have flanged end connections.

2.13.06 All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt weldings ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

2.13.07 All gun metal body valves shall have screwed ends.

2.13.08 All flanged end valves/specialities. shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints.

2.14.00 Non-return valves (Check valves)

2.14.01 Non return valves shall be of swing check (reflux) type or dual plate (for handling clear water application) type.

2.14.02 The valves shall conform to the following specifications.

i)	Design Standard	:	IS:5312, BS:1868, BS:5153 API 594/ API 60(6D) or Equivalent.
ii)	Type	:	Swing check Type (or Dual plate type) and Flanged ends.
iii)	Material of Construction (For non corrosive application)		
	Body & Cover Hinge Disk/Door	:	Cast Iron : IS:210 Gr. FG 260 Cast Iron BS:1452 Gr.220 or Equivalent.
	Hinge Pin and Door/Disc Pin	:	Cast steel ASTM A 216 Gr. WCB. High tensile Brass IS:320 HT 2 or BS:2872 Equivalent.
	Disc facing ring	:	Stainless steel
	Body Seat ring	:	Stainless steel
	Bearing bushes	:	Leaded Tin Bronze IS:318 Gr.2
	Bolts	:	Carbon Steel

iv) For the application of alum, lime, coagulant aid solution, corrosive water (DM water, Decationised/Deanionised water), and air, the body, cover & Disc shall be lined with natural Rubber, PTFE or Viton. The Hinge, Hinge Pin & Disc Pin shall be coated with PVDF, or suitable elastomer. The bearing bushes shall be PTFE or Eqvt. material. Bolting shall be of stainless steel. In the absence of lining/coating, the complete valve shall be of stainless steel construction (AISI 316) for the above application.

v) For Hydrochloric acid services, the valves shall be of lined construction as specified in (iv) above, or of Hastalloy 'B' construction and Body/Disc facing ring shall be of resilient materials such as natural rubber, PTFE or viton.

vi) For alkali and sulphuric acid services, the complete valve shall be stainless steel construction (AISI-316).

vii) Dual Plate type check valves shall be of double flanged. However for smaller sizes upto 150 mm NB, lugged wafer type is also acceptable. The material of construction of spring in dual type valve shall be of INCONEL or better.

2.14.03 Body shall be permanently marked with an “arrow” inscription indicating the direction of motion of the fluid for all the check valves.

2.14.04 Check valves for Raw / Clarified / Filtered water may be offered in Gun metal construction & with threaded ends for sizes 50 NB and below conforming to IS:778 or Equivalent.

2.14.05 For Chlorine gas and Chlorinated water application check valve of Lift Ball type may be sed in PVC construction (in case of PVC pipes). In case of rubber lined pipes, the check valves of swing check type shall be lined construction as referred in Cl 4.08.02 (v) above.

2.15.00 **Globe Valves**

2.15.01 The globe valves shall have the following characteristics:

- Straight conveyed flow.
- Right angle
- Preferably, vertical stem type.

2.15.02 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

2.15.03 The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the

downstream system to be pressurised before the globe valve is opened.

2.15.04 Globe valves with Nb smaller than or equal to 2" shall be of the integral type. Valves of this type shall be so as to permit the easiest disassembly of the internals (stem and disc).

2.15.05 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

2.15.06 All motorised globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

2.16.00 **Gate valves**

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

2.17.00 **Air Release Valve**

(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.

(b) The valve shall efficiently discharge the displaced air automatically from ducts/ pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.

(c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS:210 Gr. FG 260 and spindle shall conform to high tensile brass for water.

(d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.

2.18.00 **Butterfly valves**

2.18.01 **Design/Construction**

(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS:2062 Gr B) butterfly valves instead of cast Iron body valves are also acceptable for size

above 300 mm NB diameter for water application .In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition. Bidder has to clearly indicate the material offered in the bid. No change shall be entertained during detailed engg.

(1) The valves shall be suitable for installation in any position (horizontal/ vertical etc.) and shall be of double-flanged construction. However for sizes 150 NB and below the valves may be lugged Wafer construction.

(2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.

(3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.

(4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.

(5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.

(6) The operating mechanism shall be mounted directly on or supported from the valve body.

(7) All valves shall be complete with:

- Position indicator (located in a visible place)

- Arrow indicating the flow direction;
- Adjustable mechanical stop limiting devices to prevent over
- Travel of valve disc in open/close position.
- "Tight Shut-off" Design

(8) Hand operated valves shall have the following design features:

- Local hand controls
- The hand controls shall close the valve with clockwise rotation.
- The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.
- The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.
- Handwheel shall be made of malleable iron with arms and rims of adequate strength. The handwheel of diameters 300mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure.
- Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.
- Valves-350Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with handwheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.
- Limit and torque switches (if applicable) shall be enclosed in water tight enclosures alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

2.18.02 **Material of Construction (Butterfly Valves)**

Materials and other design details shall be as indicated below:

(a) **Cast Iron Butterfly Valves**

Body & Disc	:	ASTM A48, Gr. 40 with 2% Ni/ IS:210. Gr. FG-260, with 2% Ni and epoxy coated
Shaft	:	BS 970 431 S:291 / EN 57, or AISI-410 or AWWA permitted shaft material equivalent to EN-57/AISI-410 or better.
Seat ring	:	18-8 Stainless steel
Seal	:	Nitrile Rubber

(b) **Stainless Steel Butterfly Valves**

Body & Disc	:	ASTM A 351, Gr. CF8M
Shaft	:	ASTM A 182, Gr. 316
Disc & Seat Rings	:	EPT/BUNA-N/Neoprene

(c) **Carbon steel Butterfly Valves**

Body & Disc	:	ASTM A 216, Gr. WCB
Shaft	:	ASTM A 182, Gr. 304
Disc & Seat Rings	:	EPT/BUNA-N/Neoprene

(d) **Austentic Ductile Iron (cast) Butterfly valves**

Body & Disc	:	ASTM A 439 D2 and epoxy coated internals
Shaft	:	SS - 316
Seat Rings	:	18-8 Stainless steel
Seal	:	EPT/BUNA/NEOPRENE / EPDM

2.18.03 **Proof of Design Test (Type Test) for Butterfly Valves**

Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder in the presence of Employer's representative.

All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body &

seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504.

2.19.00 **MATERIAL OF CONSTRUCTION (GATE/ GLOBE/ CHECK VALVE)**

(a) The materials shall generally comply with the following:

(1) **Cast Steel Valves**

Body & bonnet	:	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for check valves	:	ASTM A 216 Gr. WCB/ ASTM A 105
Trim	:	ASTM A 182 Gr. F6

(2) **Stainless steel valves**

Body & Bonnet	:	ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304
Disc	:	-do-
Trim	:	ASTM 182 Gr. F. 316

(3) **Cast iron valves**

Body & bonnet	:	BS 1452 Gr. 14/ IS-210 Gr. FG 260
Seating surfaces and rings	:	13% chromium steel
Disc for non-return valves	:	BS 1452 Gr. 14/IS-210 Gr FG 260
Hinge pin for check valves	:	AISI 316
Stem for gate globe valves	:	13% chromium steel
Back seat	:	13 % chromium steel

(4) **Gun Metal valves**

Body and bonnet	:	IS 318 Gr. 2/ Equivalent Standard
Trim	:	-do-

(5) **Austenitic Ductile Iron (Cast) Valves**

Body & bonnet	:	ASTM-A-439, D-2(internals epoxy painted)
Seating surfaces and rings	:	Stainless steel

	Disc for non-return valves	:	ASTM-A-439 D2 (epoxy painted)
	Hinge pin for non-return valves:		AISI 316
	Stem	:	Stainless steel
	Back seat	:	Stainless steel

(b) Cast iron body valves shall have stainless steel stem and seat.

(c) Material for counter flanges shall be the same as for the pipings.

2.20.00 **Float operated valves**

(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.

(b) DESIGN AND CONSTRUCTION FEATURES

The following design and construction feature of the valve shall be the minimum acceptable.

- Valves shall be right angled or globe pattern.
- Valves shall be balance piston type with float ball.
- Leather liner shall not be provided.
- The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS:210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.
- Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
- The valves shall have flanged connections.

2.21.00 Ball Valves

1) Valves shall be with Welded/Flanged ends, Full-bore type and Split Body & Seat supported construction and design standard shall be BS:5351 or Equivalent.

2) Material of construction:

a)	Body :	Carbon Steel/Cast Iron
b)	Ball :	Stainless steel ANSI 420
c)	Seat ring	PTFE
d)	Stem	Stainless steel AISI 420

e) Seats Nitrile rubber; PTFE

3) Valves shall be designed to be directly operatable by a wrench/ Hand lever.

4) Suitable stops shall be provided for both the fully open and close condition.

5) All valves shall be provided with an indicator for showing the position of the ball port.

2.22.00 Valves for Alum, Coagulant-aid, Decationsed, Deanionsed and Demineralised water application

2.22.01 Butterfly valves or Saunder's patented diaphram valves shall be used for the services of alum, deanionised, decationised and demineralised water application for isolation purposes.

2.22.02 Diaphragm valves shall conform to the following requirements.

a) Valve shall be Flanged ends and with lined body, sealed bonnet, weir pattern, tight shut off type. Design standard Valve shall be BS:5156 or equivalent of required rating/ class.

b) Material of Body/Bonnet shall be Cast Iron (IS:210 Gr FG260) /Cast Steel ASTM A-216 Gr WCB) and body shall be lined with Soft Natural rubber/Ebonite Polypropylene. Diaphragm shall be of Reinforced rubber, hypalon /approved equivalent. Compressor, Stem & Bush shall be stainless steel.

c) Hand wheels shall be marked with the direction of closure. Valves shall be provided with a position indicator to show the open and closed condition. Valves provided with pneumatic actuators shall be provided with a handwheel for manual operation. The valves operators shall be designed as per relevant International Standard

2.22.03 Butterfly valves shall generally conforming specified requirements for water application except that Body of the valve shall be lined (minimum 3 mm) with natural rubber/ebonite/ polypropylene and Disc shall be lined with PVDF, polypropylene, or natural rubber and Seat rings shall be of Nitrile rubber or Hypalon.

2.23.00 Valves for Acid & Alkali Services

Valves shall be Saunder's patented diaphragm type. The valves shall conform to requirements in Clause 4.02.00 above except that Diaphragm shall be of reinforced TEFLON, EPDM/Black Butyl/approved equivalent for acid services and reinforced Neoprene/Hypalon/ approved equivalent for alkali services.

2.24.00 Valves for Lime Slurry / Solutions & Resin transfer lines

2.24.01 Plug valves shall be used for the application of lime slurry /lime solutions.

2.24.02 Plug valve shall be Flanged and non-lubricated type. Design standard Valve shall be

BS:5353 or equivalent of required rating/class.

2.24.03 Material of Body & Cover shall be Cast Iron IS:210 Gr.FG.260 or Cast steel. Plug, Gland, Gland nut shall be Stainless steel. Sleeve (Body) or Seat shall be PTFE.

2.24.04 Valves shall be operated by permanently fitted wrench or Hand lever. Wrench shall be mounted so that they are parallel to the valve bore axis when the valve is in fully open condition. All valves shall be provided with an indicator for the position of the plug part. Suitable stops shall be provided for the fully open and fully closed positions of the valve. Valves of size of 250 NB and above shall be provided with a suitable reduction gear unit.

2.24.05 Plug valves in resin transfer line of Condensate Polsihing Plant shall be of two way eccentric plug type as manufactured by De Zurik or approved equivalent. The valves, shall have type 316 stainless steel body and bearings, resident faced plug and flanged ends and pressure rating should be in line with system requirement of service vessels.

2.25.00 Valves for Chlorine gas (Wet/Dry) and Chlorinated Water Application

2.25.01 The type of valves shall be as per the schematic (P & ID) flow diagram which is enclosed as a part of the Technical Specification. However, the contractor may offer the valves in line with the Chlorination Plant Supplier (Manufacturer) recommendations and practice. The Valves in Chlorine gas (Wet/Dry) liquid chlorine and Chlorinated water lines shall be approved design of Chlorine Institute-USA and the Chief Controller of Explosives - INDIA.

2.25.02 The Materials of construction of various types of valves are indicated for the guidelines of the Contractor.

(i) Needle Valve (Chlorine gas Shut off Valve)

a)	Body	:	Bronze (Silver plated) / Brass
b)	Needle	:	Monel
c)	Valve seat	:	Teflon / Monel
d)	Stem	:	Monel
e)	Gland / Gland nut	:	Bronze/ Brass
f)	Packing	:	Teflon

(ii) Ball Valve (Liquid Chlorine)

a)	Body	:	Carbon Steel
b)	Ball	:	PVDF / Monel

	c)	Stem	:	Stainless Steel AISI 316 L
	d)	Bolts & nuts	:	AISI 316 L
	e)	Gland / Gland nut	:	Bronze/ Brass
	f)	Seat ring	:	PTFE

(iii) Angle type needle valve (For tonne container isolation)

a)	Body	:	Bronze (Silver plated) / Brass
b)	Needle	:	Monel
c)	Valve seat	:	Teflon / Monel
d)	Stem	:	Monel
e)	Gland / Gland nut	:	Bronze/ Brass
f)	Packing	:	Teflon

(iv) Butterfly type Valve /Ball Valves (Isolation of Chlorinated Water in PVC pipes)

a)	Body	:	PVC
b)	Shaft	:	Carbon Steel nickel plated
c)	Disc / Ball	:	PVC
d)	Seating ring	:	Viton
e)	Packing (Ball Valve)	:	PTFE
f)	Bush / O –ring (Butterfly type)	:	EPDM, PVDF

(v) Diaphragm Valves (in Chlorinated water in lined steel pipe):

These valves shall conform to Cl 4.02.03 above.

2.26.00 Valves in Sludge pipe line application

Sluice valve (as per relevant Standard) or knife edge type slide (as per applicable standard) valves shall be used in the sludge and drain pipe lines

2.27.00 Gates

Design standard for gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS:3042 or Equivalent. For sizes not covered under the gates shall generally as be per IS:13349. All the parts of gates shall be applied

with the coats of heavy duty bitumastic paint. 4.13.05 Each of the gates shall be provided with hand wheel, and a position indicator. The gates for DM plant & Condensate Polishing Plant drains shall be rubber lined to a minimum thickness of 4.5 mm

2.28.00 PAINTING OF VALVES

Two (2) coats of primer followed by three (3) coats of enamel of approved colour code/shade (usually same as that of connected piping) shall be applied to all exposed surfacs except stainless steel surface and Galvanised steel surface at shop as required to prevent corrosion, before despatch. The use of grease/oil other than light grade mineral oil, for corrosion protecton is prohibited. The total DFT of paining shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

2.29.00 TANKS AND ACCESSORIES

2.29.01 The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/ IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.

2.29.02 **Design & Construction**

(a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650.

(b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.

(c) Design temperature of vessels shall be 10 deg.C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation.

(d) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.B (or equivalent).

(e) The joint efficiency factors to be adopted for design calculations shall be in

accordance with the specified design code.

(f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.

(g) The material for flanges shall be of ASTM A 105/ IS-2062 Gr.B.

(h) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.

(i) Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of more than two sections longitudinal seams shall be offset.

(j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.

(k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing DM water, Alkaline water or Power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals. Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at zero level) via. a seal-trough so as not to come directly in contact with atmosphere.

(l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.

(m) Tank supporting arrangement as approved by the Employer shall be provided with all plates/ angles/ joints/ flats and supporting attachment including lugs, saddles, legs etc.

(n) Piercing nozzles/pipes from tank body / dish ends shall be adequately compensated as per the relevant code.

(o) Tank fabrication drg. and design calculations shall be approved by the Employer.

2.29.03 **Corrosion protection**

(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required, shall be taken into consideration.

(b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.

(c) Each tank, shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.

(d) Epoxy-coating shall be provided on the inside of vessel in three coats(minimum) resulting in total thickness of not less than 150 micron in which ever case required, such as equipment cooling water overhead tank, sodium hydroxide tank, condensate storage tank, condensate surge tank, DM Water tank etc.

2.29.04 **Cleaning & Painting**

(a) Inside surface of all tanks shall be protected by anti-corrosive paints as required.

(b) For tanks/vessel requiring epoxy painting, all inside surface shall be blast cleaned using non siliceous abrasive after usual wire brushing.

(c) Outside surfaces of all vessels shall be provided with two coats of primer with three (3) coats of chlorinated rubber paint of approved colour for non-coastal environment.

2.29.05 **Technical Particulars of Reserve Feed Water Tank**

Sl. No.	Description	Technical Particulars
(i)	Quantity per CC Module	One (1)
(ii)	Useful Capacity of each Tank	Not les than 150 Cu meter
(iii)	Size (Dia.x length)	Adequate
(iv)	Design Standard	ASME Section-VIII. Div.-I/IS:2825 (Class 3.)
(v)	Material Construction	MS Plates to IS:2062 Gr.B/ASTM A36.
(vi)	Accessories Required	Vent, overflow and drain, Sample Connection, Level Indicator, Level Transmitter

Note: Number/ capacity /size of tank are minimum for bidder's offer purpose. It is bidder's responsibility to design/ size these tanks depending upon system requirement/

	design during detail engineering and submit the design calculation to the Employer for approval alongwith tank GA Drawing. Additional Control & Instrumentation facilities specified elsewhere in the technical specification shall also be incorporated by the bidder.
2.30.00	**RUBBER EXPANSION JOINTS**
2.30.01	All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.
2.30.02	The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
2.30.03	The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.
2.30.04	The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.
2.30.05	Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
2.30.06	Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.
2.30.07	Expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. Basic fabric for the' duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.
2.30.08	Expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.
2.30.09	All expansion joints shall be provided with stainless steel retaining rings for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.
2.30.10	Expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges.

2.30.11 All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.

2.30.12 Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.

2.30.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.

2.30.14 Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.

2.31.00 **STRAINERS**

2.30.01 **Simplex type**

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows:

(a) Body — IS:318, Gr. 2 upto 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. For DM water.

(b) Strainer Element — Stainless steel (AISI 316)

(c) End connection — Screwed upto 50 mm Nb, and Flanged above 50 mm Nb

2.31.02 **Duplex type**

(a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.

(b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

	Body	:	IS:318, Gr. 2 upto 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. B and internally epoxy-painted above 50 mm NB.
	Strainer element	:	Stainless steel (AISI 316)
	End connection	:	Screwed upto 50mm Nb, and flanged above 50 mm Nb. Gasket shall be of full face type

(c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.

(d) Size of the strainer and flow direction will be indicated on the strainer body casting.

(e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100 % clogged condition exerting shut-off pressure on the element.

f) For DM water service, body shall be rubber lined to minimum 4.5 mm thickness (soft rubber of shore Hardness 65 ± 5°A)

2.31.03 **Y-Type Strainers**

a) Y-Type strainer for water application shall be constructed of following materials:

i.	Body	:	Cast Iron IS:210 Gr. FG 260 for raw/clarified/ filtered water application and Austenitic Ductile Iron to ASTM–A-439 Gr D2 for sea water
ii.	Strainers	:	Wire shall be stainless steel (AISI:316) 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel (SS-316) construction.
iii.	Drain plugs/ Nuts	:	SS-316

b) Y-Type strainers shall also conform to Cl. 4.10.01 (b), (c), (d), (e) and (f).

c) Body of the Y-type strainers of alkali, and demineralised water shall be of Cast Iron (IS:210, Gr.FG 260) and lined with soft or hard rubber to a thickness of 3 mm.

d) For acid services, apart from the rubber lined body material, the screen material, shall be Polypropylene or HDPE wire cloth of suitable mesh and thickness.

e) Strainers for the application of chlorine gas (Wet / Dry) and liquid chlorine shall be of standard make and type of the chlorination plant manufacturer and

material of construction shall be suitable for the duty conditions.

2.32.00 Resin Traps

a) The resin traps for the Ion exchange vessels shall be provided for the collection of Ion exchange resin shall conform to the following:

b) The body shall be of mild steel (IS:2062) and lined internally with rubber (Hard/Soft rubber), Saran or polypropylene. The internals (rod and screen) for all resin traps shall be of AISI 316 construction. All screen components shall be welded at each intersection of wire and support rod for good strength, Resin traps screen opening shall not exceed 120 percent of the associated process vessel under drain/backwash collection header nozzle screen opening and shall be suitably selected to retain even the minimum size of the resin selected for the process.

c) The resin traps shall be provided with a draining arrangement with a valve for collection of trapped resins. Resin trap body shall have lifting lug for easy handling during maintenance/erection.

2.33.00 General Requirements for Valves, Gates, Strainers and Resin traps

a) Valves, Strainers etc for the Chlorination Plant shall be got approved by the Chief Controller of Explosives-INDIA, by the contractor.

b) Sizes of the valves shall be same as that of the interconnected pipe sizes except for the control valves.

c) The various equipments shall be installed so that they are easily approachable for the operating and maintenance personnel. Generally Valves shall be located about 1.2 metre to 1.5 metre from the operating platform and also they shall not be located below the ground level such as beneath the trenches etc. In such cases, extended spindle shall be provided with chain operating from operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. The position indicator for such valves shall be also provided along with the stand.

However valves which are provided (in the buried pipe line) with a valves chamber shall have manual operator/ hand wheel inside the valve chamber. The valve chamber shall be provided with built in ladders/ staircases and sufficient operating space within the chamber shall also be provided for easy operation of such valves.

d) All the valves, strainers, resin traps etc. shall be provided with external painting as that of the interconnected piping as specified in above. However, surfaces such as Stainless Steel, aluminum, copper, brass, bronze and other non-ferrous materials shall not be painted. No paint or filter shall be applied until all repairs, hydrostatic tests and final shop inspections are completed, but shall be applied prior to shipment

CLAUSE NO.	PAINTING (M21)
1.00.00	**PAINTING**
1.01.00	**General**
	(a) All the Equipments and steel structures shall be protected against external and internal (if any) corrosion by providing suitable painting as described below unless otherwise specified elsewhere. However, the surfaces of stainless steel, Galvanised steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.
	(b) All painting shall be carried out in conformity with the paint manufacturer's recommendation.
	(c) This chapter is not applicable for equipment/structures/surfaces which encounter temperatures exceeding 50 deg.C. For such equipment / structures/surfaces, the painting specifications shall be as per bidder standard practice, unless specified elsewhere, shall be followed.
1.02.00	**Cleaning and Surface Preparation**
1.02.01	The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying paint by brushing, shot blasting etc as per the agreed procedure.
1.02.02	After all machining, forming and welding has been completed, all steelwork surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to painting.
1.02.03	Surfaces shall be cleaned to requisite surface preparation by one of the methods given below as per technical specification and all dust remaining after cleaning shall be removed.
1.02.04	Grease or oil contamination shall be removed by either wiping or scrubbing the surface with rags or brushes wetted with white spirit and then wiping down with clean dry cloths. Alternatively emlusifying agents may be used for this purpose.
	(a) Manual or hand tool cleaning
	The sequence of operation for manual/hand tool cleaning is as follows:
	(i) Solvent cleaning (if requiredf) will be done to remove oil and grease soluble welding influx residues and salts.
	(ii) Surface will be manually cleaned by hand hammering or hand chipping to remove stratified rust (rust Scale).
	(iii) Brushing/hand scraping will be done to remove all loose mill scale and nonadherent rust.

(b) Blast Cleaning

The surface of the metal will be blast cleaned to a finish confirming to SA 2 1/2 as per Swedish standard SIS-05-5900 using any of the following methods after removal of grease, oil and contaminants;

(i) Dry sand blasting

(ii) Shot/grit blasting

1.03.00 **Protective Coating**

1.03.01 As soon as the painting items have been cleaned, within four hours of the subsequent drying they will be coated with suitable anti-corrossion protection. Immediately after the protective coating all vessels and pipes will be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds. Cylinderical plugs will not be driven into the ends of pies. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

1.03.02 No painting or filler shall be applied until all repairs, hydrostatic test and final shop inspection are completed.

1.03.03 All painting works (including surface preparation) on piping or equipment at site shall be commenced only after the required tests have been completed.

1.03.04 Prior to painting, proper care shall be taken to protect nameplates, lettering, gauges, sight glasses, light fittings and similar such items, to ensure that these are in no way defaced or damaged during the work

1.03.05 All primers shall be well marked into the, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied as per manufacturer's recommendations.

1.03.06 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks.

1.03.07 Dry film Thickness

Each coat of paints will be allowed to harden before the next is applied as per manufacturer's recommendation. The requirements for the dry film thickness (DFT) of the paint and materials to be used for different items will be as per the "schedules of finishes indicated in subsequent clauses.

1.04.00 **Painting Specification**

(a) Structural and supporting steel work in general - Schedule - 1

(b) Equipment in general - Schedule - 2

(c) Equipment and including pressure vesels structural steel, steel support etc. in Pretreatment plant, Chlorination Plant Building, CW Chemical Treatment System,demineralisation plant and other area handling acid/alkali corrosive liquids, DM water and permeate storage tanks Degassers, CW side stream filters

(for external surfaces) - Schedule - 2

(for internal surfaces) - Schedule - 3

(d) Internal and external surfaces of Panel and Bus Duct - Schedule - 6

(e) Piping in Pretreatment (Chemical House), Chlorination Plant Building, CW Chemical Treatment System, Demineralising plant and other area handling acid/alkali corrosive liquids - Schedule - 2

Piping above ground in adjacent of above area - Schedule - 2

Piping above ground in other area - Schedule - 1

2.00.00 **SCHEDULE OF FINISHES**

2.01.00 **Schedule - 1 For Synthetic Enamel Paint**

Surface Preparation	:	Manually Cleaned
Primer	:	Three (3) coats of red oxide zinc chromate Primer, DFT 25 microns per coat.
Finish Coat	:	Three (3) coats of Synthetic enamel paint with glossy finish, DFT 25 microns per coat.
Total DFT	:	100 Microns (Minimum)

2.02.00 **Schedule - 2 For Chlorinated Rubber Paint**

Surface Preparation	:	Manually Cleaned
Primer	:	One (1) coat of chlorinated rubber based high build zinc phosphate primer, DFT 50 microns per coat.
Intermediate coat	:	One (1) coat of high build micaceous (chlorinated rubber) coating, DFT 50 microns per coat
Finish Paint	:	Three (3) coats of high build chlorinated rubber paint, DFT 25 per coat.

	Total DFT	:	200 microns
2.03.00	**Schedule - 3 For Unmodified Epoxy Paint**		
	Surface Preparation	:	Sand blasting
	Primer	:	One (1) coat of epoxy resin cured with polyamide hardener, DFT 25 microns
	Finish Paint	:	Two (2) coats of epoxy resin cured with amine adduct hardener, DFT 100 microns per coat.
	Total DFT	:	225 microns
2.04.00	**Schedule - 4 For Modified Epoxy resin painting**		
	Surface Preparation	:	Manual cleaning
	Primer	:	One (1) coat of modified epoxy resin cured with polyamide amine hardener, DFT 125 microns
	Finish Paint	:	Two (2) coats of epoxy coal tar cured with polyamine, DFT 80 microns per coat
	Total DFT	:	285 microns
2.05.00	**Schedule - 5 For Primer**		
	Surface Peparation	:	Manually Cleaned
	Primer	:	Suitable rust preventive primer based on service/operating conditions of DFT 25 micron/ coat
	Total DFT	:	50 microns
2.06.00	**Schedule - 6 For Synthetic enamel paint for Panel & Bus Ducts.**		
	Surface Preparation	:	The surface shall be chemically cleaned by seven tank process
	Primer	:	Two (2) coats of red oxide zinc chromate primer
	Finish Paint	:	Two (2) coats of synthetic enamel paint with glossy finish
	Total DFT	:	100 microns
	Alternatively to above, Powder coating will be provided		

	Surface Preparation	:	The surface shall be chemically cleaned by seven tank process
	Phosphating	:	A zinc calcium phosphate coating confirming to IS: 3618
	Finish Paint	:	Uniform Power coating

2.07.00 **Schedule - 7 For Polyurethane finish paint**

	Surface Preparation	:	Sand/Shot blasting
	Primer	:	Two (2) coats of chemical resistant high build primer
	Finish Paint	:	Two (2) coats of polyurethane finish paint
	Total DFT	:	100 microns

2.08.00 **Schedule - 8 DCS cabinets, Control Desk, GT & STG Contrll System Cabinets and other C&I Panels/Cabinets**

The Regarding painting refer to C&I Specifications Volume-III, Part-B.

2.09.00 **Schedule - 9 Aluminium Paint**

	Surface Preparation	:	Sand blasting
	Primer	:	Two (2) coats of zinc silicate primer of DFT 25 microns
	Finish Paint	:	Two coats of heat resistant Aluminium paint capable of withstand 200^{O}C, of DFT 25 microns per coat
	Total DFT	:	100 microns

Note: The painting schedule and colour code of Main Plant equipment viz. Gas Turbine Generator, Steam Turbine Generator, Condenser, GT and ST auxiliareis will be as per manufacturer's standard.

2.10.00 **COLOUR CODING SCHEME**

2.10.01 **Colour Code for Equipment**

Major equipment with their shades and RAL ISC numbers are given in Annexure-1. These colours and ISC numbers correspond to the Indian Standard IS-5 (Colours for ready mixed paints and enamels).

2.10.02 **Colour Code for Pipelines**

In case of pipelines, shades and ISC numbers are given in Annexure-I.

2.11.00 **GALVANIZING (If Required)**

All galvanizing will be carried out by the hot dip process.

Attention will be paid to the detail design of members. Adequate provision for filling, venting and draining will be made for assemblies fabricated from hollow sections. Vent holes will be suitably plugged after galvanizing.

All surface defects in the steel including cracks, surface laminations, lamps and folds will be removed. All drilling, cutting, welding, forming and final fabrications of unit members and assemblies wil be completed before the structures are galvanized. The surface of the steel work to be galvanized will be free from welding slag, paint, oil grease and similar contaminants.

The minimum average coating weight will be 0.61 kg/m^2 as specified in IS 4759.

On removal from the galvanizing bath the resultant coating will be smooth, continuous, free from gross surface imperfections such as bare spots, lamps, blisters and inclusions of flux, ash or dross.

ANNEXURES

Annexure-1 : Colour Scheme

I. Colour Scheme for Equipment

Sl.No.	Equipment	Colour	RAL/ISC Number	Remarks
(A)	**Mechanical**			
1.0	**GT exhaust system**			
1.1	Bypass stack	Heat resistant aluminium	–	
1.2	Transition duct	Heat resistant aluminium	–	
1.3	Diverter damper and guillotine damper	Heat resistant aluminium	–	
1.4	Seal air fan and seal air piping	Light Admiralty Grey	697	
1.5	Structure support and accessories	Dark Admiralty Grey	632	
2.0	**HRSG and auxiliaries**			
2.1	Blow down vessels	Aluminium cladding		
2.2	Main Stack	Aluminium cladding		
2.3	HRSG support structure and accessories	Dark Admiralty Grey	632	
2.4	HP dosing skid	Dark Admiralty Grey	632	
2.5	Insulated carbon steel/alloy piping and fittings, drums and blow down tanks	–	–	

Sl.No.	Equipment	Colour	RAL/ISC Number	Remarks
3.0	**Fuel Gas System**			
3.1	Knock-out vessels	Canary Yellow	309	
3.2	Fuel gas condensate tank	Light Brown	410	
3.3	Filters	Canary Yellow	309	
4.0	**Raw Water System**			
4.1	River water pumps	Sea Green	217	
4.2	CW make-up pumps	Sea Green	217	
4.3	Raw Water feed pumps	Sea Green	217	
4.4	Service water pumps	Sea Green	217	
4.5	Fire water pumps and accessories	Fire Red	536	
4.6	Potable water pumps	Sea Green	217	
4.7	DM Plant supply pumps	Sea Green	217	
5.0	**Demineralization Plant**			
5.1	Pressure sand filters (PSF)	Sea Green	217	
5.2	Activated carbon filters (ACF)	Sea Green	217	
5.3	Cation exchangers	Sea Green	217	
5.4	Anion exchanger	Sea Green	217	
5.5	Degassed water tanks	Sea Green	217	
5.6	Degassed water towers	Sea Green	217	
5.7	Degassed water blowers	Sky blue	101	

Sl.No.	Equipment	Colour	RAL/ISC Number	Remarks
5.8	Degasser water pumps	Sea Gren	217	
5.9	Mixed bed (MB) units	Sea Green	217	
5.10	Air blowers for MB & PSF	Sky Blue	101	
5.11	Acid/Alkali storage and measuring tanks	Dark Violet	796	
5.12	Acid unloading pumps	Dark Violet	796	
5.13	Alkali unloading pumps	Dark Violet	796	
5.14	Regeneration water pumps	Sea Green	217	
5.15	Neutralized effluent disposal pumps	Sea Green	217	
6.0	**DM water tanks**	Sea Green	217	
7.0	**Condensate storage tank**	Sea Green	217	
8.0	**HRSG fill pump**	Sea Gren	217	
9.0	**Cycle make-up pumps**	Sea Green	217	
10.0	**Chlorination System**			
10.1	Chlorine ton containers	Golden Yellow	356	
10.2	Booster pumps	Sea Green	217	
11.0	**CW System**			
11.1	CW Pumps	Sea Green	217	
11.2	Auxiliary cooling water pumps, valves	Sea Green	217	
11.3	Closed cooling water pumps, valves	Sea Green	217	
11.4	CCW Make-up tank	Sea Green	217	

Sl.No.	Equipment	Colour	RAL/ISC Number	Remarks
11.5	Auxiliary cooling water plate heat exchangers	Sea Green	217	
12.0	**CW Treatment System**			
12.1	Acid storage and metering tanks	Dark Violet	796	
12.2	Acid unloading pumps and dosing pumps	Dark Violet	796	
13.0	**Side stream filter**	Sea Green	217	
14.0	**Compressed air system**			
14.1	Compressors	Sky Blue	101	
14.2	Driers	Dove Grey	694	
14.3	Air receivers	Sky Blue	101	
15.0	**Cranes & Hoists**			
15.1	Cranes	Golden Yellow	356	
15.2	Mono rails & chain pulley systems	Golden Yellow	356	
15.3	Hooks	Signal Red	537	
16.0	**Ventilation and Air conditioning system**			
16.1	Condensing unit/compressor	Sky Blue	101	
16.2	Condenser cooling water pumps	Sea Green	217	
16.3	Ventilation fans	Light Grey	631	
17.0	**Effluent Treatment Plant**			
17.1	Sump pumps	Sea Green	217	

Sl.No.	Equipment	Colour	RAL/ISC Number	Remarks
17.2	Effluent disposal pumps	Sea Green	217	
17.3	Dosing tanks	Dark Violet	796	
17.4	Blowers	Sky Blue	101	
17.5	Oil water separator	Light Brown	410	
18.0	**Trash Racks**	Galvanized	--	
19.0	**Stoplog Gates**		--	Hot Zinc spray of nominal thickness of 100 micron as per BS:5493/IS-5905
(B)	**Electrical & Instrumentation**			
1.0	**Transformers**			
1.1	Indoor transformers	Pebble Grey	RAL 7032	
1.2	Outdoor LT transformers	Pebble Grey	RAL 7032	
2.0	Battery charger	Pebble Grey	RAL 7032	
3.0	Motors	Light Grey	631	
4.0	HT/LT Switchgear			
4.1	Interior	Glossy White	--	
4.2	Exterior			
	- MCC/PCC	Light Grey	631	
	- DC distribution board	Light Grey	631	
	Panels			
5.1	GTG & STG control system cabinet			
	- Internal	Refer to C&I Specification Vol.-III, Part-B		

Sl.No.	Equipment	Colour	RAL/ISC Number	Remarks
	- External	Refer to C&I Specification Vol.-III, Part-B		
5.2	Electronic system cabinets (DCS)			
	- Internal	Refer to C&I Specification Vol.-III, Part-B		
	- External	Refer to C&I Specification Vol.-III, Part-B		
5.3	Local conrol panels			
	- Internal	As per manufacturer's standard	--	
	- External	Light Grey	631	
6.0	Intercom equipment			
	- Hand sets	As per manufacturer's standard	--	
	- Cable junction boxes	Light Grey	631	
7.0	Lighting Equipment / Panels			
	- Interior	Glossy	-	
	- Exterior	Siemens Grey	RAL 7032	
8.0	Lighting poles	Aluminium	-	(Refer Note 1)
9.0	Cable trays	Galvanized	-	
10.0	Diesel Generator Set	Smoke Grey	692	
11.0	High Speed Diesel day tank	Light Brown	410	

Note:
(1) Poles will be provided with black bituminous paint internally and externally for embedded portion.

(II) Colour Scheme for Pipelines

Sl. No.	Medium	Ground Colour		First Colour		Legened	Remarks
		Colour	ISC No.	Colour	ISC No.		
1.	Main/Auxiliary/ Bled Steam	Aluminium*		Signal Red	537		
2.	Exhaust/vent	Aluminium*		Canary Yellow	309		
3.	Feed Water	Sea Green	217	Gulf Red			
4.	Untreated/Raw Water/Service Water	Sea Green	217	White	--	RW	
5.	De-mineralized	Sea Green	217	Light Orange	557	DMW	
6.	Cooling Water/ circulating Water	Sea Green	217	French Blue	166	CW	
7.	De-mineralized water for cooling purposes	Sea Green	217	Light Orange	557	DMC	
8.	Condensate make-up line to condenser	Sea Green	217	Light Brown	410	CM	
9.	Potable (Drinking) Water			French Blue	356	DW	GI Pipes
10.	Instrument Air			French Blue	--	IA	GI Pipes
11.	Service/Plant air			Silver Grey	--	SA	GI Pipes
12.	Natural Gas	Canary	309	--	--	NG	Hazard mark to be given
13.	Lubricating oil	Later					Refer Note 2

Sl. No.	Medium	Ground Colour		First Colour		Legened	Remarks
		Colour	ISC No.	Colour	ISC No.		
14.	Hydraulic Power	Later					Refer Note 2
15.	Control Fluid	Later					Refer Note 2
16.	Transformer Oil	Light Brown	410	Light Orange	557	TR.O	
17.	Fire Water	Fire Red	536	Crimson Red	--	Fire	
18.	Acid piping	Dark Violet	796	Signal Red	537	Chemical formula	Hazard to be given
19.	Alkali piping	Dark Violet	796	Golden Yellow	356	Chemical formula	Hazard to be given
20.	Chemical Feed	Dark Admiralty Grey	632				
21.	HSD	Light Brown	410			HSD	Hazard mark to be given

Note:

(1) * -Aluminium to be used where pipes are not already clad with aluminium sheets.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
1.00.00	**GENERAL**
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such person shall function from the Site office of the Contractor during the pendency of Contract.
2.00.00	**REGULATION OF LOCAL AUTHORITIES AND STATUTES**
2.01.00	In addition to the local laws and regulations, the Contrator shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.
3.00.00	**WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING** The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements :
3.01.00	**Qualification of Weld Procedures** All the welding procedures adopted by the Contractor shall be qualified in accordance with the latest applicable requirements of Section IX of ASME code before the work is begun. The Contractor shall submit to the Employer for review, copies of certificates qualifying welding procedures proposed to be used. Such certified welding procedures for

welding of pressure parts and pipings submitted to the Employer shall clearly state the type of material, material thickness, the joint details, the pre-heat temperature maintained, the post weld heat treatment given and the welding current and the voltage used during qualifications of welding procedures.

3.02.00 **Welders' Qualification**

Only welders, qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site in consultation with and to the requirements of the Employer, prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.

All the welders carrying out welding at site, shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorised to carry out welding. All such badges shall be countersigned by the Employer.

3.03.00 **Records**

All records of the welding procedures, the welders' qualification tests and the welders' performance details for the work performed under these specifications shall be maintained by the Contractor in a manner acceptable to the Employer. The names of all the welders who made each weld on the boiler pressure parts other equipments, wherever applicable, covered under this package and piping within the jurisdiction of the Indian Boiler Regulations shall be maintained by the Contractor. The certified copies of any or all the above documents shall be submitted to the Employer on request.

3.04.00 **Marking**

On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.

4.00.00 **HEAT TREATMENT**

4.01.00 Pre-heating, post-heating and post - weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local postweld

stress relieving heat - treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations.

4.02.00 After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (Clause 7.00.00 of this Part-A, Volume-VIII) etc.

5.00.00 **WELD EDGE PREPARATION**

Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200 mm length at the cut face shall be removed by machining.

6.00.00 **CLEANING AND SERVICING**

6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipe lines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.

6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial /Trial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.

6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.

7.00.00 **FIELD WELDING SCHEDULE**

The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field welding schedule to be issued by the Contractor shall contain the following :

a) Drawing No (s)

b) Location of the weld

c) Size of the weld (outside diameter and thickness)

d) Type of joints

e) Material specifications

f) Size of fillet on backing ring, when the type of joint is with backing ring

g) Electrode/ filler metal specifications

h) Number of welds per unit

i) Quantity of filler metal per weld

j) Indication of required Non-destructive Examination (NDE) for each weld

k) Pre-heat temperatures for welding

l) Process of welding

m) Post-welding heat treatment temperature ranges, duration, under clause 4.00.00 entitled "Heat Treatment" in this Part-A, Volume-VIII.

n) Qualification details of weld procedures to be adopted as specified under clause 3.01.00 entitled ' Qualification of Weld Procedures' in this Part-A, Volume-VIII.

8.00.00 **SITE RUN MISCELLANEOUS PIPING**

Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located for convenient operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipe between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.

9.00.00 **THERMAL EXPANSIONS**

All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.

10.00.00 **PIPING SUPPORTS**

10.01.00 Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.

10.02.00 The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature

conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.

11.00.00 **PRESSURE TESTING**

11.01.00 On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor.

11.02.00 All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated.

11.03.00 Thy hydraulic test shall be considered successfull only on certification to that effect by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.

12.00.00 **THERMOWELLS AND FLOW NOZZLES**

12.01.00 All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.

12.02.00 All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.

13.00.00 **INSULATION, LAGGING AND CLADDING**

The provision of insulation, lagging and cladding of the various equipment and portion of the equipment covered under the Contract, shall be in accordance with the following specifications unless otherwise specified elsewhere or agree to separately in writing.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
13.01.00	**Turbine Generator**
13.01.01	The Gas Turbine, Steam Turbine, H.P. cylinder, I.P. cylinder (if applicable), steam chest and interconnection piping, cross - over/cross - around piping, such parts of L.P. cylinder as considered necessary, feed heating system, feed pumps, drain coolers, ejectors, deaerator and its storage tank including all accessories, flash vessels, H.P., I.P. (if applicable) and L.P. bypass systems and all associated piping and valves shall be efficiently insulated with inner thermal insulating materials. The insulated portion of the steam turbines shall be covered with fabricated steel cover, provided with suitable anti-drumming and sound pressure attenuating material inside. The insulation and steel covering should be so designed and erected as to provide easy accessibility to parts requiring frequent inspection.
13.01.02	The thermal insulation for the turbine casing shall consist of sprayed insulation produced by projecting specially prepared mineral wool along with a fine liquid spray. This should be covered with prefabricated 'blanket' type insulation. These blankets shall consist of high temperature felted mineral insulation fully enclosed in wire inserted asbestos cloth. A single layer of blanket shall not be more than 75 mm thick. Voids around the blankets should be avoided. However, unavoidable voids shall be filled with loose mineral wool.
13.01.03	Nuts and other exposed portions of the casing and valve flanges shall be suitably insulated for minimum heat loss.
13.01.04	The density of the mineral fibre felt shall be carefully controlled at about 200 kg/m^3 and the thermal conductivity of mineral wool shall be 0.052kcal/m. hr. ^{0}C at mean temperature.
13.01.05	Suitable stainless steel lugs shall be tack welded on turbine casing to support the insulation. In places where welding is not permitted, suitable alternative arrangement shall be provided by the Contractor. The design of the support shall be so as to involve minimum number of lugs.
13.01.06	The mineral wool shall be capable of passing standard combustibility test, both immediately after application and also after being subjected to its maximum operating temperature for not less than 100 hours. The mineral wool shall be free from objectionable odour at the ambient conditions in which it is used. The mineral wool shall not contain substances which will support pests or encourage growth of fungi. The mineral wool shall not suffer permanent deterioration as a result of contact with moisture due to condensation. The mineral wool shall not suffer quality deterioration under the specified conditions of use. In this connection, both hot and cold face temperatures are relevant. The mineral wool shall be capable of being applied to the

surface concerned without causing corrosion of the surface being insulated or the cladding on it under normal site conditions.

13.01.07 The thermal insulation designed, furnished and installed by the Contractor shall be such that the following items of performance shall be guaranteed, and the specific design and application features adopted shall be so as not to exceed the stipulated limits in temperature differentials. The Employer shall have the option to have any random check of specimen as per his choice, to establish conformity to guaranteed particulars :

a) The temperature difference between the cold face of finished insulation and ambient shall not be more than 15^0C. The ambient temperature shall be considered as 45^0C.

b) The difference in temperature between upper and lower metallic parts of H.P. and I.P. casings in the zone of governing stage/ steam admission shall not be more the 40^0C during cooling of the casing.

c) The difference in metallic temperatures of upper and lower halves of both H.P. and I.P. casings, during normal operating conditions shall not be more than 15^0C.

13.02.00 **Associated Equipment**

13.02.01 In case of equipment other than steam turbine, lugs made out of MS rods of 5 mm dia conforming to IS280 or equivalent shall be welded on the surface at intervals of 250 mm pitch zig-zag to support insulation. Mineral wool mats with wire netting on both sides shall be applied against the surface with lugs piercing through. The edges of mattress shall be laced together with galvanised MS 0.71 mm dia (22 SWG) IS 280 or equivalent (soft) lacing wire. Galvanized binding wire of 1.63 mm dia (16 SWG) IS 280 or equivalent (soft) will be used criss-cross between lugs to hold it. The lugs will then be bent over the netting.

13.02.02 Unless otherwise specified, all equipment insulation shall be covered with aluminium cladding/ jacketing. The thickness of aluminium sheet shall not be less than 0.63 mm. Galvanic corrosion shall be prevented by carefully avoiding permanent contact of aluminium cladding with copper, copper alloys, tin, lead nickel or nickel alloys including monel metal. Where cladding is attached to carbon steel or low alloy steels, the steel shall first be prime painted with zinc chromate and then painted with aluminium paint. The use of lead base paints for this purpose shall be avoided.

13.02.03 Prior to application of cladding, all surface imperfections such as depressions, cracks and voids shall be filled with insulation cement so as to form a smooth base. All overlaps at longitudinal joints shall face downwards. The fixing of cladding shall be

by means of screws and they shall be adequate in number and be placed in such location as to produce tight joints eliminating 'bellying'. The screws, as far as possible, shall be uniformly placed and on centres not exceeding 150 mm except where insulated outside diameters are smaller than 230 mm in which case spacing shall be on centres not exceeding 100mm. Self tapping type screws, of 12 mm size of stainless steel/aluminium alloy as per the requirements shall be used. All joints wherever possible shall be lapped a minimum of 50 mm. The overlaps of longitudinal joints shall be a 10 mm turnback edge. Butt joints such as those at piping tees, shall be made using a rolled seam. Suitable provisions for expansion movement shall be provided in joints. Hinged or sliding doors for convenience shall be provided in the cladding at all access openings, non-projecting connections, important codes stampings etc.

13.03.00 **Piping, Pipe Fittings & Valves**

All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.

13.03.01 The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.

13.03.02 **Flanges**

Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.

13.03.03 **Bends and Elbows**

Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.

13.03.04 **Cladding**

Cladding shall be of aluminium sheets of at least 20 SWG thick and shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action, as stipulated under clause 13.02.02 above shall be taken.

13.03.05 **Valves and Fittings**

All valves and fittings installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.

13.04.00 **Protection of Equipment during Insulation Applications**

All equipment and structures shall be suitably protected from damage while applying insulation. After completion of insulation, all equipment and structures shall be thoroughly cleaned and also remove insulating materials which might have fallen on them shall be removed.

14.00.00 **CODE REQUIREMENTS**

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules Codes, Indian Boiler Regulations, ASME codes and accepted good practice, the Employer Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
15.00.00	**CONDENSER ASSEMBLY AND CONNECTIONS**
15.01.00	If the condenser shells call for site assembly, care shall be taken in the assembly of shells, and the correctness of alignment shall be checked in a manner acceptable to the Employer prior to stitch welding. With stitch welding over, and on clearance of final alignment by the Employer, final welding shall be done by 'seam method' so as to ensure a minimum deformation of the welded parts. Only approved welders shall perform such welding operation. All the weld seams shall be properly ground and subjected to non-destructive examination. At least 10% of butt welded seams shall be subjected to radiographic examination.
15.02.00	If the superstructure portion or the upper portions of the condenser are not welded to the condenser shell in the Contractor 'works, then they shall be properly aligned with the Condenser shells at site. Any special fixtures required for such alignment shall be furnished along with the equipment and made use of by the Contractor. All welding shall be done as prescribed under in this volume above and the weld seams shall be properly ground and subjected to dye-penetrant test.
15.03.00	The Contractor shall be governed by the following conditions during condenser tubes insertion and expansion.
15.03.01	The condenser shall be installed in its position prior to tube insertion. Tube insertion and expansion shall not be carried out in the open.
15.03.02	The tubes shall be free from any dents, mechanical damages or any other defects caused during the storage.
15.03.03	Both ends of the tube where tube expansion has to be carried out shall be thoroughly cleaned to a length of 100 mm to remove oil, grease etc. The cleaning shall be done with a fine emery paper.
15.03.04	The surfaces of the holes in the tube plates and the tube support plates shall be thoroughly cleaned and shall be free from paint, corrosion spots, oxide scales etc. The method adopted by the Contractor for such cleaning of the holes shall meet the approval of the Employer. Final cleaning shall be performed by a chemical cleaning agent like Carbon Tetra Chloride.
15.03.05	The cleaned surfaces of the tubes and the reamed tube plate holes shall be free from any longitudinal scratches.
15.03.06	Tubes shall be inserted such that their ends shall project out 2 to 3 mm beyond the tube plate outer surface. The tube shall then be expanded using an electronic

	automatic torque control tube expanding unit or pneumatic tube expander so as to get 4% thinning of the tube walls and the elongation of the tube ends shall be 0.40 to 0.60 mm. Tube expansion shall be so controlled that neither over expansion nor under expansion of the tubes takes place. Tube expansion shall be checked with a dial bore gauge indicator. Tube expansion shall be carried out to a length of 70% to 80% of the tube plate thickness. In no case, the expansion shall go beyond the tube plate thickness. The tube insertion shall be such that the excess length of all tubes shall be at the same tube plate and they shall be cut off by a cutting tool followed by expansion. Both ends of tubes after expansion shall be flanged properly. Finally, proper chamfering shall be carried out. Expansion of condenser tubes shall start from the peripheral holes of the tube plate and shall proceed towards the centre of the tube plate in such a sequence as to avoid any deformation of the tube plate.
15.04.00	In case the condenser in supported on springs and the condenser neck is directly welded to the L.P. cylinder exhaust hood, then the final lifting and installation of the condenser on permanent support shall be carried out only after final installation of the L.P. casing. It shall be ensured that all spring supports are evenly loaded and the gap between the condenser and the spring supports is within +/- 1.0mm. Suitable adjusting bolts shall be used to further lift the condenser till the clearance between condenser neck and L.P. exhaust hood is suitable for welding and such clearances shall not exceed 3.0mm. The welding of the above connection shall be performed as called for as prescribed in this volume above. Suitable machined permanent spacers shall be provided and the condenser load shall gradually be transferred on the these spacers from temporary bolts.
15.05.00	**Hydrostatic and Hydraulic Tests**
15.05.01	The Hydrostatic testing of condenser steam space shall be carried out after connecting all the pipes with the condenser alongwith the condenser vacuum system by filling the steam space with water upto one (1) meter above the top row of tubes. Any leakage detected shall be rectified immediately.
15.05.02	The water space shall be tested hydraulically alongwith the circulating water lines, after assembly of the waterbox doors.
15.05.03	After the hydraulic testing, the waterboxes tube plates and covers shall be given suitable coatings of anti-corrosive paints. The paints and painting shall meet the approval of the Employer.

16.00.00	**TURBINE GOVERNING, LUBRICATION AND SEAL OIL SYSTEM CONNECTIONS AND CLEANING**
16.01.00	The Contractor shall ensure that prior to starting the assembly of oil piping, all connected equipment like oil pumps, oil coolers, main oil tanks, generator seal oil unit etc. are finally erected in position on respective foundations. The pipelines shall first be temporarily assembled to ensure correct fitting of the circuit. All valves shall be thoroughly cleaned and serviced to the satisfaction of the Employer prior to their installation in the oil pipe line. Adequate and appropriate number of flange connections shall be introduced in the line to render the dismantling of pipe lines convenient for cleaning.
16.02.00	After temporary assembly, the pipe line shall be dismantled and cleaned as specified herein. The pipe interior shall first be mechanically cleaned with wire brush thoroughly, through out the full length of the pipe till such time the internal surfaces are totally free from dust, dirt, rust etc. After mechanical cleaning, the line shall be blown with compressed air and then cleaned by effective acid washing process.
16.03.00	The pipe system shall then be reassembled and installed after which the same shall be subjected to hydraulic test with oil for at least twice the normal operating pressure. Suitable corrective action shall be taken for defects noticed during the test and the system retested again for the above specified pressure.
16.04.00	Final cleaning of the oil system shall be performed by oil flushing till such time all the pipe lines, and the system are thoroughly cleaned to the level recommended by the turbine manufacturer. Upon completion of flushing operation, the system shall be drained, the oil reservoir cleaned and required quantity of fresh clean oil filled.
17.00.00	**ELECTRICAL SAFETY REGULATIONS**
17.01.00	In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer.
17.02.00	Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall: a) Satisfy the Employer that the appliance is in good working condition; b) Inform the Employer of the maximum current rating, voltage and phases of the appliances; c) Obtain permission of the Employer detailing the socket to which the appliances may be connected.

	The Employer will not grant permission to connect until he is satisfied that a) The appliance is in good condition and is fitted with a suitable plug. b) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.
17.03.00	No electric cable in use by the other Contractor/ Employer will be disturbed without permission. No weight of any description will be imposed on any such cable and ladder or similar equipment will rest against or be attached to it.
17.04.00	No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.
17.05.00	The Contractor shall employ the necessary number of qualified, full time electricians to maintain his temporary electrical installation.
18.00.00	**REMOVAL OF MATERIAL** No material brought to the Site shall be removed from the Site by the Contractor and/ or his Sub-Contractors without the prior written approval of the Employer.
19.00.00	**INSPECTION, TESTING AND INSPECTION CERTIFICATES** The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in this Volume of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.
20.00.00	**ACCESS TO SITE AND WORKS ON SITE**
20.01.00	Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.
20.02.00	In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on

the Site, except by the special permission, in writing by the Employer or his representative.

21.00.00 **CONTRACTOR'S SITE OFFICE ESTABLISHMENT**

The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

22.00.00 **CO-OPERATION WITH OTHER CONTRACTORS**

22.01.00 The Contractor shall co-operate with all other Contractors or tradesmen of the Employer, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the Works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his Works.

22.02.00 The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.

23.00.00 **DISCIPLINE OF WORKMEN**

The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or is incompetent, negligent or otherwise undesirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

24.00.00	**CONTRACTOR'S FIELD OPERATION**
24.01.00	The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.
24.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.
25.00.00	**PHOTOGRAPHS AND PROGRESS REPORT**
25.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
25.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.
25.03.00	The Contractor shall submit the progress of work in CDs (2 copies) quarterly highlighting the progress and constraints at site.
26.00.00	**MAN-POWER REPORT**
26.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.

26.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.
27.00.00	**PROTECTION OF WORK**
	The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the Clause 22.00.00 above entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.
28.00.00	**EMPLOYMENT OF LABOUR**
28.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
28.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
28.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.
28.04.00	Contractor's employees shall wear identification badges while on work at Site.
28.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contact Labour Regulation Abolition Act or any other law due to

act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's Bills.

29.00.00 **FACILITIES TO BE PROVIDED BY THE EMPLOYER**

29.01.00 **Space**

The Contractor shall advise the Employer within thirty (30) days from the date of acceptance of the Notification of Award about his exact requirement of space for his office, storage area, pre-assembly and fabrication areas,labour and staff colony area, toilets etc. The above requirement shall be reviewed by the Employer and space as decided by Employer will be allotted to the Contractor for construction of his temporary structures/ facilities like office, storage sheds, pre-assembly and fabrication areas, labour colony area, toilets etc.

29.02.00 **Electricity**

The Contractor has to arrange the construction power from the Discom. Contractor has to include in his scope all the related requirements for construction power.

29.03.00 **Water**

Free supply of water will be made available for construction purposes from Employer terminal point. Any further distribution will be the responsibility of the contractor. Free drinking water will also be provided at one point in the site. Further distribution shall be the responsibility of the Contractor.

29.04.00 **Cranes**

29.04.01 EOT cranes provided in Gas Turbine Hall and Steam Turbine Hall procured under this package shall be used by the Contractor in the TG hall for erection of these units. For equipments which can not be handled by these cranes, the Contractor shall make his own arrangements.

29.04.02 Bidders shall clearly bring out in his offer the proposed method of installation of gas turbine and steam turbine generator equipments. This shall be supported by detailed write up, drawings & other technical data.

30.00.00 **FACILITIES TO BE PROVIDED BY THE CONTRACTOR**

30.01.00 **Contractor's site office Establishment**

The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.

30.02.00 **Tools, tackles and scaffoldings**

The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailor, etc. for the purpose of fabrication, erection and commissioning.

30.03.00 **First-aid**

30.03.01 The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.

30.04.00 **Cleanliness**

30.04.01 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

30.04.02 The Contractor shall control the fugitive dust as follows:

(a) Ash / Earth excavated should be stockpiled properly at designated areas so as not to cause air pollution.

(b) The road suface should be provided with gravel as cover.

(c) Water sprinkling arrangement should be made for unpaved roads.

(d) Any other measure considered appropriate by the Employer.

31.00.00 **LINES AND GRADES**

All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at

Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.

32.00.00 **FIRE PROTECTION**

32.01.00 The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.

32.02.00 Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

32.03.00 All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.

32.04.00 The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, etc. Access to such fire protection equipment, shall be easy and kept open at all time.

33.00.00 SECURITY

The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.

34.00.00 **CONTRACTOR'S AREA LIMITS**

The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contactor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.

35.00.00 **CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER**

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.

36.00.00 **PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS**

36.01.00 **General**

36.01.01 The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.

36.01.02 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be

responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.

36.01.03 The Contractor upon completion of installation of equipments and systems, shall conduct precommissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All precommissioning/commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.

36.02.00 **TESTING/ COMMISSIONING SCHEDULE**

The Contractor shall submit to the Employer, his **testing/ commissioning schedules** for various equipments/ systems covered under the contract, for approval, at least 8 months before the actual commissioning of the equipment/ systems.

The testing/ commissioning schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of documents and commissioning checks to be submitted and their content details shall be agreed upon during preaward discussions.

The list of model commissioning documnets viz. standard checklists, testing/ commissioning schedules and the details regarding contents of testing/ commissioning schedule are enclosed as annexures I to IV at the end of this Volume. These schedules are indicative only.

i)	Annexure-I	:	Testing Schedules & Commissioning Schedules.
ii)	Annexure-II	:	Standard Checklist of Items.
iii)	Annexure-III	:	List of Commissioning & Test Procedures/ Schedule to be approved by the Employer.
iv)	Annexure-IV	:	Brief write-up on Contents of Testing Schedule.

36.03.00 **PRECOMMISSIONING ACTIVITIES**

The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of

	checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.
36.03.01	**Gas Turbine**
36.03.01.01	Oil flushing of Lube Oil system, Control Oil, jacking oil system, seal oil systems etc. for GTG shall be done. Entire flushing oil requirement and other consumables alongwith flushing equipment shall be met by the contractor. Flushing shall be as per the approved flushing procedure.
36.03.01.02	Air Intake Filtration system of the Gas Turbine shall be checked for cleanliness, loose parts and proper mounting of Pulse air cleaning system equipment.
36.03.01.03	Fuel Gas Line shall be cleaned by compressed air blowing after hydrotest. Before charging the gas pipeline it shall be purged by Nitrogen. Functional test for all equipment in Fuel Gas Conditioning and supply system shall be done.
36.03.01.04	Functional test for Equipment of Exhaust Gas system of the Gas Turbine e.g. Diverter Damper, Guillotine damper, Seal Air System and Hydraulic units for Dampers shall be done.
36.03.01.05	All tests and activities pertaining to the Gas Turbine and its Generator as per Manufacturer's recommendation shall be conducted.
36.03.01.06	Any other check / tests and activities mutually agreed between the Contractor and Employer.
36.03.02	**Heat Recovery Steam Generator**
36.03.02.01	**Hydraulic Testing of Pressure Parts**
36.03.02.02	On completion of installation of the HRSG pressure parts, and the high pressure external piping a hydraulic test in accordance with the requirements of the Indian Boiler Regulations, shall be performed by the Contractor. The procedure adopted for hydraulic test and preservation shall have the prior approval of the Employer. The water for hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the steam generator and high pressure external piping shall be suitably drained and preserved. All the valves, high pressure piping and interconnected pipes connecting the pressure parts, shall be subjected to hydraulic test along with the pressure parts. All blank

flanges or any removable plugs required for openings not closed by the valves and pipings shall be furnished by the Contractor. The pressurisation equipments including water piping from the supply, and any chemicals for preservation, needed for the above test shall also be furnished by the Contractor. Any defect noticed during the testing shall be rectified and the unit shall be retested by the Contractor.

The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR.

36.03.02.03 **Chemical Cleaning of Pressure Parts**

The Contractor shall perform thorough and efficient cleaning operations of all the internal parts of the boiler, like economiser, water wall / evaporator, separator, feedwater line, piping, start-up recirculation lines and associated piping and all other pressure parts and associated high pressure piping covered under these specifications (except those portions which are to be steam blown).

The cleaning operation shall consist of D.M. water flushing, the chemical cleaning by once through circulation using acids like hydrofluoric acid (or as recommended by the manufacturer), DM water rinsing, DM water flushing, nitrogen capping etc. Complete chemical cleaning procedure, the scheme and layout including parameters of the pumps, size of tanks, materials of construction, the rate of consumption and total requirements of steam and water for such cleaning process shall meet the approval of the Employer.

The Contractor shall furnish all labour, materials such as the required chemicals and other consumables, all equipment such as acid transfer and acid circulating pumps complete with drive motors, acid storage and acid mixing tanks, all temporary piping, valves and specialities and local instruments for pressure, temperature and flow measurements and any other items needed to carry out the process.

The Contractor shall take care to dispose off the used chemicals and the effluents from the cleaning operations, after neutralisation, meeting all the statutory regulations and in a manner acceptable to the Project Manager and which would comply with the norms of the Delhi Pollution Control Committee /CPCB.
The Contractor shall specifically make all necessary arrangements for prevention of any fire accidents, explosions etc. during the performance of the chemical cleaning operations.

The Contractor shall ensure that during the cleaning process the procedure adopted shall be such as to consume minimum demineralized water.

The cleaning procedure shall include final flushing and draining of the boiler under a nitrogen gas cap and/or fillling the boiler with inhibited water or any other proven procedure recommended by the manufacturer for the preservation of the boiler which is acceptable to the Employer. The Contractor shall furnish a detailed procedure for boiler preservation during detailed engineering for Employer's approval.

All equipment needed for such preservation including interconnecting piping and any regulating equipment for N_2 cap and other preservatives (excluding the nitrogen cylinders), shall be provided by the Contractor for the steam generator and the same shall also become the property of the Employer after completion of the chemical cleaning.

The Contractor shall provide adequate safety and protective equipment for all his employees. Specialised treatment equipment (such as required for first aid when using hydrofluoric acid) for hydrofluoric acid) for heat recovery steam generators must be provided at place of handling acid. An acid clean report and log of each clean must be provided by the Contractor to the Employer.

36.03.02.04 **Steam Blowing of Superheater, Reheaters and Steam Lines**

Steam blowing of complete Superheaters, Reheaters and various external pipelines shall be carried out by the Contractor as per requirements/scope of work (indicated in Part-A, Section-VI) of this specification. In addition if any other piping, not specifically mentioned in the scope of the Contractor and is also required to be steam blown, the Contractor shall extend all cooperation for steam blowing of these additional piping during steam blowing operation.

The Contractor shall give recommended procedures, method of blowing and scheme for steam blowing indicating clearly additional system, if any, to be cleaned by steam blowing and furnish data/ write-up/ layouts/ drawings to that effect to the Employer for the Employer's approval.

The Contractor shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for steam blowing, which in any case shall meet the steam turbine-generator requirements.

The systems which should be ready and operational before steam blowing and are in the socpe of the Contractor shall be made ready/operational by the Contractor by the scheduled date for starting of steam blowing.

For equipments/components installed on high pressure external piping, such as various thermowells, flow meter, control valves, HP/LP Bypass valves etc., the Contractor shall

comply with guidelines to be followed during steam blowing, with respect to removal / blanking /replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor.

Supply of all such spools (as above) and/or blanks, temporary piping and supports etc. as required, cutting / welding / edge preparation and rewelding required for blanking, temporary piping connection and/or for replacements by spool pieces shall be the responsibility of the Contractor. After steam blowing removal of spool pieces & temporary piping and reinstallation of various components, shall also be the responsibility of the Contractor.

It will be the responsibility of the Contractor to operate the Gas Turbine and, HRSG to generate adequate steam at the parameter and quality in line with the requirements of steam blowing procedure. All necessary precautions to avoid cold end corrosion of Condensate preheater, during such oil firing shall be taken by the Contractor.

The Contractor shall ensure successful and timely completion of steam blowing of all systems and will render all help/services as required including:

i) Services of test/operating personnel/supervisors.

ii) Extending all cooperation during erection, pre-commissioning of plant and equipment to be made ready and operational before starting steam blowing.

iii) Extending all cooperation for interface engineering of equipments/components of temporary system required for steam blowing oiperation.

iv) Contractor's engineers shall be available for all coordination meetings arranged by the Employer for finalising the details of temporary system for steam blowing.

For the steam blowing operation, steam conditions like pressure, temperature etc. at the steam generator outlet shall be so selected that a mnimum cleaning ratio/ disturbance factor of 1.6 is achieved. A cycle of heating, cooling and blowing/ purging, is to be repeated to ensure thorough cleaning of the interior of the pipes/ tubes etc. The final indication of cleanliness shall be demonstrated by purging through target plates positioned at the discharge point.

36.03.02.05 Any other precommissioning activity such as floating of safety valves etc. as considered essential for readiness of facilities for commencement of commissioning activities shall also be undertaken by the Contractor (Refer Annexure-I, II & III).

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
36.03.03	**Steam Turbine-Generator and Auxiliaries/ BFPs /CEPs /Condenser/ Vacuum pumps and other Auxiliaries**
36.03.03.01	In addition to various tests and activities associated with completion of erection & pre-commissioning, following tests & activities shall also apply.
36.03.03.02	Hydraulic Test for HRSG integral piping and heaters, heat exchangers, condenser tubes & condnser, equipment cooling water system pipes and associated equipment etc. shall be done. The hydrauic test of other piping system as per statutory requirement and specified elsewhere shall also be carried out. All equipment needed for the tests shall be furnished by the Contractor.
36.03.03.03	Oil flushing of lube oil system, control fluid & jacking oil system, seal oil systems etc. for STG. Entire flushing oil requirement & refilling with fresh oil and other consumables alongwith flushing equipment shall be met by the Contractor.
36.03.03.04	Stator water flushing, HP/IP/LP bypass tests, vacuum tightness test as per approved procedures shall be done by the Contractor after arranging & lining up of all the necessary equipment by him.
36.03.03.05	Steam blowing & chemical cleaning, as applicable of integral piping of the turbo-generator & other piping (such as condensate lines etc.) in the scope of the Contractor shall be done by the Contractor following the same guidelines as given in case of the steam generator and elsewhere in the specification.
36.03.03.06	All tests and activities pertaining to the ST generator as per manufacturer's recommendations and as given in Annexure-I, II & III of Volume-VIII, Part-A and elsewhre in the technical specification as applicable shall be conducted.
36.03.03.07	Any other pre-commissioning checks/ tests and activities as described elsewhere in the technical specifications and those mutually agreed between the Contractor & the Employer shall be undertaken by the Contractor.
36.03.04	**Balance of Plant Equipment & Systems** All pre-commissioning tests & activities as indicated in Annexure-I, II & III of Part-A, Volume-VIII and elsewhere in the technical specification shall be performed by the Contractor.
36.04.00	**COMMISSIONING OF FACILITIES**
36.04.01	**General** Upon completion of precommissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.

Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.

36.04.02 The Commissioning tests/checks shall specifically include but will not be limited to following :

(a) Checks on the operation of all controls of Gas Turbine's startup system.

(b) Checks on operation of Gas Turbine's Governing system.

(c) Checks on operation of Gas Turbine's Ignition system.

(d) Checks on operation of On Base Gaseous Fuel system.

(e) Checks on operation of Air Intake System of the Gas Turbine.

(f) Checks on operation of compressor wash system of the Gas Turbine.

(g) Checks on operation of Diverter Damper, Seal Air system and Guillotine Damper of Gas Turbine's exhaust system.

(h) Condenser vacuum test, feed water heater operational tests for establishing correct cascaded flow, heater water levels etc. & checking of all parameters as per approved heat balance diagrams.

(i) Test for HP/IP/LP bypass valves operation & their control system.

(j) Test for operation of governing control system for Gas Turbines and Steam Turbines.

(k) Standard commissioning tests and procedures as per Contractor’s practice for steam turbine generator, steam generator and other equipment / auxiliaries within the Contractor’s scope of work.

(l) Checks on operation of all individual control loops in the steam generator control loops in the steam generator control system and turbine generator control system.

(m) Checks on inter-relation between each control loop in the Gas Turbine and Bottoming plant. Checks on inter-relation between each control loop in the turbine generator control system.

(n) Checks on correct functioning of Gas Turbine Protection System, Steam Turbine Protection System, Supervisory Control System for Gas Turbine and Steam turbines, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).

(o) Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.

(p) Tests on C&I Equipments :

The Contractor shall finalise the protocol of check lists with the employer, after erection of the system and equipment, as per International Codes/Standard.

The Contractor shall furnish requisite no. of copies of procedures and list of start up, precommissioning, commissioning and initial operation tests for Employer's approval.

The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be.

Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.

36.04.03 **Initial Operation**

Upon completion of system checking/tests as per 36.04.01 and 36.04.02 above and as a part of commissioning of facilities, module shall be put on initial operation for a period of fourteen (14) days as stipulated in General Technical Requirements.

37.00.00 **MATERIALS HANDLING AND STORAGE**

37.01.00 All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.

37.02.00 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely

	responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
37.03.00	The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.
37.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.
37.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
37.06.00	All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Employer.
37.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
37.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
37.09.00	All the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.
37.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
37.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such

as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space . The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.

38.00.00 **CONSTRUCTION MANAGEMENT**

38.01.00 The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.

38.02.00 The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Sub-Contractors and in such a case the Contractor if called, will also attend such meetings.

38.03.00 **Time is the essence of the Contract** and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

38.04.00 The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

39.00.00 **FIELD OFFICE RECORDS**

The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions

of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

40.00.00 **CONTRACTOR'S MATERIALS BROUGHT ON TO SITE**

40.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

40.02.00 The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

40.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under clause 40.02.00 above and credit the proceeds thereto to the account of the Contractor.

41.00.00 **PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY**

41.01.00 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

41.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his

Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.

42.00.00 **PAINTING**

All exposed metal parts of the equipment including pipings, structure railings, etc. wherever applicable, after installation unless otherwise surface protected, shall be first painted with at least two coats of suitable primer which matches the shop primer paint used, after throughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved by the Employer for painting. Afterwards, the above parts shall be finished painted three two coats of allowed resin machinery enamel/epoxy paints. The minimum thickness of paint film shall not be less than 100 microns. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the Employer.

43.00.00 **INSURANCE**

43.01.00 In addition to the conditions covered under the Clause entitled “Insurance” in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor’s own or his Sub-Contractor’s manufacturing Works.

43.02.00 **Workmen’s Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable under the Workmen’s Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor’s employees, which for any reason are not covered under the Workmen’s Compensation Act, 1948. The liabilities shall not be less than Workmen’s Compensation As per statutory Provisions Employee’s liability.

43.03.00 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer’s men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated :

Fatal Injury : Rs.100,000 each person
: Rs.200,000 each occurrence

Property Damage : Rs.100,000 each occurrence

43.04.00 **Comprehensive General Liability Insurance**

43.04.01 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).

43.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

43.05.00 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

44.00.00 **UNFAVOURABLE WORKING CONDITIONS**

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

45.00.00 **PROTECTION OF MONUMENTS AND REFERENCE POINTS**

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be preformed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The

	Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.
46.00.00	**WORK & SAFETY REGULATIONS**
46.01.00	**General**
46.01.01	The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.
46.01.02	The Contractor shall follow PPCL Safety Rules as issued from time to time with respect to safety in construction & erection.
46.01.03	The contractor shall have the approved Safety; Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Employer.
46.01.04	The contractor shall prepare the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas. Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents and submit to Engineer In charge for approval as per the format of Safety plan as annexed at Table–A.
46.01.05	The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.
46.01.06	All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.
46.01.07	The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer In charge shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.

46.01.08	The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.
46.01.09	The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of PPCL and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any' unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of PPCL safety documents as stated above.
46.01.10	The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured. The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998. Their health records shall be maintained accordingly and to be submitted to Employor when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Employor. The medical fitness certificate to be submitted to Employor.
46.01.11	First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.
46.02.00	**Emergency Action Plan** The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.
46.04.00	**Scaffolding** The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are

designed by a competent person and it erection and repairs should be done under the expert supervision- The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.

46.04.00 **Opening**

The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. When ever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.

46.05.00 **Explosives**

The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.

46.06.00 **Fencing of Machinery**

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

46.07.00 **Carrying of Excessive Weight by a Worker**

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.

46.08.00 **Dangerous and Harmful Gases / Equipment**

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by Engineer in-charge to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

46.09.00 **Overhead Protection**

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards

46.10.00 **Working at Heights**

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher velevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arresters) for climbing/getting down through ladders to prevent fall from height

46.11.00 **Handling of Hazardous Chemicals**

The Contractor will notify well in advance to the Engineer-In-Charge of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. PPCL shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly

adhere to and comply with such instructions. The Engineer In-charge shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe; he may forbid its use. No claim due to such prohibition shall be entertained by PPCL and PPCL shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer-In-charge shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by PPCL, the Contractor shall use alternative methods with the approval of the PPCL without any cost implication to the PPCL or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer In-charge In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities; the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions- AU precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

46.12.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

46.13.00 **Excavation**

The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable-warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

46.14.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.

No electric cable in use by the Contractor /Employer will be disturbed without prior permission. No weight of any description will be imposed on any cable and no ladder or similar equipment will rest against or attached to it.

The Contractor shall employ necessary number of qualified, full time Electricians/ electrical supervisors to maintain his temporary electrical installations.

46.15.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

46.16.00 **Lifting Appliances, Tools & Tackles. Lifting Gear And Pressure Plant & Equipment etc.**

The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure

Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.

46.17.00 **Excessive Noise, Vibration**

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules. Noise Pollution (Regulation and Control) Rules, 2000.

46.18.00 **Electrical Installations**

46.18.01 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the PPCL, he shall

46.18.02 Satisfy the Engineer I/C that the appliance is in good working condition;

46.18.03 Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;

46.18.04 Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that;
The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

46.18.05 No repair work shall be carried out on any live equipment. The Employor must declare the equipment safe and a permit to work shall be issued by the PPCL / Contractor as the case may be to carry out any repair /' maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.

46.18.06	The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. The installations are provided with suitable ELCBs and RCCBs wherever required.
46.19.00	**Safety Organisation**
46.19.01	The contractor employing more than 250 workmen whether temporary, casual, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the PPCL Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub contractor shall also be considered as the contractor's employees/workmen for the above purpose. In case of contractor deploying less than 250 workmen he should designate one of his Engineer/supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engineer./ supervisor should get at least 2days safety training from any reputed organization or from PPCL before resuming the work. If already trained in past the declaration along with Training Certificate shall be furnished to PPCL safety officer.
46.19.02	The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the Engineer-In-Charge with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.
46.20.00	**Reporting of Accident and Investigation** In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer in-charge, PPCL Safety Officer with a copy to PPCL Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws
46.21.00	**Right to stop Work**
46.21.01	The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a -way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and

possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

46.21.02 The Contractor shall not be entitled for any damages / compensation for stoppage of work, [Sub-Clause XVIII (I)] due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

46.22.00 **Fire Protection**

The contractor shall provide sufficient fire extinguishers at place(s) of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards/ TAC/ IRDA. The employees shall be trained to operate the fire extinguishers / equipment.

46.23.00 **Penalties**

46.23.01 If the Contractor fails in providing safe working environment as per the Safety Rules of PPCL or continues the work even after being instructed to stop the work by the Engineer-In-Charge as provided in Clause 46.21.01 above, the Contractor shall be penalized at the rate of Rs. 25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer-In-Charge. However, in case of accident, the provisions contained in Sub-Clause 46.23.02 shall also apply in addition to the penalties mentioned in this sub-clause.

46.23.02 If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or PPCL's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to PPCL as per the following schedule; -

a)	Fatal injury or accident causing death	Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less.
b)	Major injuries or accident causing 25% or more permanent disablement to workmen or employees.	Penalty @2.5 % of contract value or Rs.1,00,000/- per person whichever is less

Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time.

46.23.03 If any contractor worker is found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height, the Engineer in-charge / Safety Officer of PPCL shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer-in-charge / Safety Officer of PPCL will also issue a notice in this regard to the contractor

46.23.04 If two or more fatal accidents occur at same PPCL site under the control of contractor during the period of contract and he has

(1) not complied with keeping adequate PPEs in stock

(2) defaulted in providing PPE's to his-workmen

(3) not followed statutory requirements / PPCL safety rules

(4) been issued warning notice/s by PPCL head of the project on non observance of safety norms

(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in PPCL for two years from the date of last accident.

The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by PPCL. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evaluation of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.

TABLE - A

SAFETY PLAN

1. Safety policy of the Contractor to be enclosed.
2. When was the safety policy last reviewed.
3. Details of implementation procedure/methods to implement Safety Policy/Safety Rules.
4. Name, Qualification, experience of Safety Officer.
5. Review of Accidents, Analysis Method, Methods to ensure Safety and Health.
6. Unit executive responsible to ensure Safety at various levels in work area.
7. List of employees trained in safety employed before execution of the job. Give the details of training.
8. Safety Training Targets, Schedules, methods adopted to providing safety training to all employees.
9. Details of checklist for different jobs/work and responsible person to ensure compliance (copy of checklist to enclosed).
10. Regular Safety Inspection, Methods and Periodicity and list of members to be enclosed.
11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity.
12. Implementation of Recommendations of Audit/Inspections. Procedures for implementation and 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 legislation.
16. Issue of PPEs to employees, Periodicity/Stock on hand etc.

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT
47.00.00	**FOREIGN PERSONNEL**
47.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.
47.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
47.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.
47.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements.
47.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time or full-time nor shall they take part in any local politics.
47.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
48.00.00	**FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES**
48.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.

48.02.00	All the equipment/ equipment bases, shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer.
48.03.00	The concrete foundation surfaces shall be properly prepared by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.
48.04.00	**Grout** The grout shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm^2 at 28 days. The grout shall be chloride - free, cement based, free flowing, non-metallic grout. The Grout shall have good flowability even at very low water/ grout powder ratio. The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use. The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.
48.05.00	**Placing of Grout**
48.05.01	After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.
48.05.02	The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.
48.05.03	In addition to the above, recommendations of Grout manufacturer shall also be followed.

48.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

48.07.00 **Checking of Equipment After Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check-up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.

49.00.00 **SHAFT ALIGNMENTS**

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall not exceed forty (40) microns and shall conform to VDI 2056.All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

50.00.00 **DOWELLING**

All the motors and other equipment shall be suitably dowelled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

51.00.00 **CHECK OUT OF CONTROL SYSTEMS**

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

52.00.00	**COMMISSIONING SPARES**
52.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.
52.02.00	These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.
53.00.00	**CABLING**
53.01.00	All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.
53.02.00	Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 metre run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.
53.03.00	Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

53.04.00 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.

53.05.00 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.

53.06.00 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

54.00.00 EQUIPMENT DELIVERY AND ERECTION

54.01.00 **General Requirements**

a) This part covers Contractor's responsibilities for packing, shipping, ware-housing and the installation of all equipment and materials furnished and installed under this specification.

b) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following :

1) Instructions for packing, shipping, receiving handling, ware-housing and storage.

2) Instructions for location and installation of equipment furnished by this specification.

3) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.

4) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.

5) Check lists and quality assurance hold points.

6) Format for all related documentation.

c) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

d) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.

54.02.00 **Crating**

a) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

b) Equipment shall be packed with suitable dessicants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.

c) Dessicants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate dessicants shall be of a chemical nature to absorb moisture. In any case, the dessicant shall not be of a type that will absorb enough moisture to go into solution. Dessicants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough dessicant shall be used for the volumes enclosed in wrapping.

d) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.

e) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.

f) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

g) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number :

a) Export case markings

b) Case number

c) Gross weight and net weight in Kilograms

d) Dimensions in centimeters

e) Complete description of material

h) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

i) Electrical equipment, control and insulations shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

j) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.

k) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.

l) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.

m) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.

n) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

o) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.

54.03.00 **Factory Assembly**

a) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.

b) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

54.04.00 **Equipment Installation**

a) **General Requirements**

i) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.

ii) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.

iii) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.

iv) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifica- tions.

b) **Installation Materials**

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

c) **Regulatory Requirements**

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

d) **Cleaning**

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

e) **Equipment Assembly**

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.

f) **Equipment Setting**

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments

shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.

All free standing instrumentation cabinets and panels shall be located within the construction tolerances of +/- 3 mm of the location dimensions indicated on the Employer's plant arrangement drawings.

g) **Free-Standing Equipment**

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

h) **Non-free Standing Equipment**

i) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a proper like manner.

ii) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified elsewhere.

i) **Equipment Location**

i) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.

ii) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.

iii) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.

iv) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.

v) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.

vi) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, please refer relevant Parts, Section-VI.

j) **Installation of Field Mounted Instruments and Devices**

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/ devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

(Also refer relevant Parts, Section VI).

k) **Piping Connections**

i) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

ii) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

l) **Equipment Checkout**

1. All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

2. After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

m) **Defects**

i) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.

ii) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

n) **Equipment Protection**

i) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

ii) The equipment shall be protected during storage as described herein.

iii) Equipment shall be protected from weld spatter during construction.

iv) **Protective Guards**
Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

v) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.

vi) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

55.00.00 WELDING - SPECIAL REQUIREMENTS

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifi-cations, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

TESTING SCHEDULES

SL. NO.	DESCRIPTION
A)	**STEAM TURBINE & ITS AUXILIARIES**
1.	TURBINE ON BARRING GEAR
2.	BEARING AND JACKING OIL INITIAL CIRCULATION
3.	HP BYPASS SYSTEM
4.	IP BYPASS SYSTEM
5.	LP BYPASS SYSTEM
6.	GOVERNOR OIL CONTROL SYSTEM
7.	VACUUM RAISING PLANT
8.	CONDENSER
9.	C.E.P.
10.	CONDENSATE SYSTEM
11.	DEAERATOR
12.	SURGE TANK
13.	FEED WATER CHEMICAL DOSING SYSTEM
14.	FEED WATER SYSTEM
15.	B.F.P.
16.	CENTRAL OIL PURIFICATION PLANT
B)	**GENERATOR & ITS AUXILIARIES**
1.	GENERATOR
2.	EXCITATION SYSTEM
3.	GENERATOR COOLING WATER CIRCUIT
4.	GENERATOR SEAL OIL INITIAL CIRCULATION

SL. NO. DESCRIPTION

5. GENERATOR GAS FILLING

C) **ELECTRICAL SYSTEM (LT SWITCHGEAR AND MISC.)**

1. TESTING SCHEDULE FOR VARIOUS LT MCCs, LT SWITCHGEARS AND AUXILIARY CONTROL PANELS

D) **CONTROL & INSTRUMENTATION**

1. GT-C&I CONSISTING OF
   - (a) GT Governing System
   - (b) GT Protection System
   - (c) OTHER (as per C&I Specification Volume-III, Part-B, Section-VI)

2. TG-C&I CONSISTING OF
   - (a) TURBINE STRESS CONTROL SYSTEM
   - (b) TURBINE PROTECTION SYSTEM AND INSTRUMENTS
   - (c) HP-IP-LP BYPASS SYSTEM
   - (d) OTHERS (as per C&I Specification Volume-III, Part-B, Section-VI)

3. BOP-C&I INCLUDING
   - (a) OLCS
   - (b) CLCS
   - (c) MMIPIS

4. OTHER GTG/HRSG/STG RELATED C&I SYSTEM

5. INSTRUMENT AND CONTROL CABLING

6. U.P.S./DC SYSTEM

7. OTHERS C&I SYSTEMS

SL. NO. DESCRIPTION

E) **EQUIPMENT COOLING WATER SYSTEM**

1. COOLING WATER SYSTEM FOR GAS TURBINE, STEAM TURBINE AND HRSG

F) **COMPRESSED AIR SYTEM**

1. PLANT AIR COMPRESSOR

2. INSTRUMENT AIR COMPRESSOR

3. COMPRESSED AIR SYSTEM

COMMISSIONING SCHEDULES

1. GAS TURBINE COMMISSIONING INCLUDING AIRINTAKE, GASEOUS FUEL SYSTEM AND GAS TURBINE EXHAUST GAS SYSTEM COMMISSIONING

2. HRSG PURGE AND OTHER INTERLOCK OPERATION

3. STEAM TURBINE GLAND SEALING SYSTEM

4. HP/ IP / LP BYPASS SYSTEM

5. TURBINE INITIAL RUN-UP

6. DEAERATOR STEAM OPERATION

7. LP CHEMICAL DOZING SYSTEM

8. GENERATOR

9. BOILER CHEMICAL ANALYSIS EQUIPMENT

10. FLOATING OF SAFETY VALVES

11. COMPRESSED AIR DRYING UNIT

12. COMPRESSED AIR SYSTEM

13. GASEOUS FUEL SUPPLY SYSTEM

SL. NO. DESCRIPTION

14. AIR INTAKE FILTRATION SYSTEM FOR GAS TURBINES

15. Combined Cycle Module Commissioning

16. CW system

17. CW Chlorination System

18. Pre Treatment Plant

19. DM Water Facilities

20. Fire Protection system

21. 220V DC system

22. Gas Sampling system

STANDARD CHECKLIST

MECHANICAL

SL. NO. DESCRIPTION

1. COMMISSIONING/ TESTING ESSENTIAL PRE-REQUISITE

VALVES

1. MANUALLY OPERATED VALVE
2. ELECTRICALLY OPERATED VALVE
3. PNEUMATICALLY ACTUATED VALVE
4. HYDRAULICALLY ACTUATED VALVE
5. SAFETY VALVE
6. STEAM TRAP
7. BUTTERFLY VALVE (ELECTRICALLY OPERATED)
8. BUTTERFLY VALVE (MANUALLY OPERATED)
9. BUTTERFLY VALVE (FOUR WAY - ELECTRICAL)
10. NON-RETURN VALVE
11. THREE WAY CONTROL VALVE
12. RELIEF VALVE
13. DIFFERENTIAL PRESSURE REGULATING VALVE
14. FLOAT OPERATED VALVES

SL. NO. DESCRIPTION

TANKS AND PRESSURE VESSELS

1. TANKS (METAL) UPTO 20 M3
2. TANKS (LARGE STORAGE)
3. PRESSURE VESSEL (BELOW 17 BARS)
4. AIR RECEIVER
5. PRESSURE VESSEL - ACCESS DOOR
6. TURBINE MAIN OIL TANK

PUMPS

1. PUMP - LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN)
2. PUMP - UPTO 350 HP (260 KW)
3. PUMP - SUMP INSTALLATION
4. GEAR PUMP/ SCREW PUMP

PIPE WORK SYSTEM

1. STEAM SERVICES
2. WATER SERVICES
3. OIL/ FIRE RESISTANT FLUID SYSTEM
4. AIR SERVICES (COMPRESSOR)
5. HIGH PRESSURE SERVICES
6. CONSTANT LOAD SUPPORT
7. SPRING SUPPORTS

SL. NO. DESCRIPTION

STRAINER AND FILTER

1. STRAINER/ FILTER BASKET TYPE
2. STRAINER ROTARY (LOW PRESSURE)
3. FILTER & STRAINERS CENTRIFUGAL SEPARATORS
4. FILTER & STRAINER Y-TYPE
5. FILTER & STRAINER (PLATE TYPE)
6. PURIFIER
7. FILTER - COMPRESSED AIR LINE

HEAT EXCHANGER

1. HEAT EXCHANGER (GENERAL)
2. HEAT EXCHANGER - OIL/ WATER

FANS & COMPRESSORS

1. FANS - AXIAL FLOW PRESSURE LUBRICATED
2. COMPRESSORS - GENERAL

DAMPERS

1. MANUALLY OPERATED
2. PNEUMATICALLY OPERATED
3. ELECTRICALLY OPERATED
4. MANUALLY OPERATED GATES
5. PNEUMATICALLY OPERATED GATE

SL. NO. DESCRIPTION

DUCT WORK

1. BOILER FLUE DUCTING
2. EXPANSION JOINTS
3. OBSERVATION & ACCESS DOOR

CRANES AND ELEVATORS

1. AUXILIARY OVERHEAD CRANE
2. TRAVEL SUPPORT STRUCTURE FOR CRANE
3. LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE
4. MAIN AUX. HOIST MOTION (CRANE)
5. CRANE, ELECTRIC HOIST

POWER TRANSMISSION

1. POWER TRANSMISSION GEAR BOX
2. BEARINGS
3. FLUID COUPLINGS

ELECTRICAL

1. D.C. MOTOR
2. HV SQUIRREL CAGE INDUCTION MOTOR
3. 415 V SQUIRREL CAGE INDUCTION MOTOR
4. MOTOR OPERATED ACTUATORS

SL. NO. DESCRIPTION

5. GENERATOR TRANSFORMER

6. UNIT AUXILIARY TRANSFORMER, STATION TRANSFORMER AND SERVICE TRANSFORMER

7. LT SWITCHGEAR/MCC

A. SWITCHGEAR ROOM

B. STANDARD CHECKLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM

C. PT CARRIAGE AND CUBICLE

D. CABLE/BUS DUCT

E. CONTACTOR MODULE

F. SWITCH FUSE MODULE

G. MASTER PANEL OF LUBE OIL PANEL

H. FEEDER PANEL OF LUBE OIL PANEL

I. SPACE HEATER AND CABLE MODULE

J. 415 V AIR CIRCUIT BREAKER

8. POWER CABLE

9. AUXILIARY CABLE

19. D.C. CABLE

11. EXPLOSION PROOF ELECTRCAL EQUIPMENT

12. JUNCTION BOX

13. CONTROL TRANSFORMER MODULE

SL. NO. DESCRIPTION

14. BRUSH GEAR ASSEMBLY

15. AUX. CONTROL AND RELAY PANEL DESK

16. BRUSH GEAR (GENERATOR SLIP RING BRUSH GEAR ASSEMBLY (IF APPLICABLE)

17. CHECKLIST FOR ALL TYPES OF RELAYS, MODULES AND SCHEMES OF GENERATOR EXCITATION SYSTEM & GENERATOR PROTECTION SYSTEM

18. INDICATING INSTRUMENT

19. RECORDING INSTRUMENT

20. INTEGRATING INSTRUMENT

CONTROL & INSTRUMENTATION

1. CONDUCTIVITY MEASURING EQUIPMENT INCLUDING TEST PROCEDURES

2. pH ANALYSER INCLUDING TEST PROCEDURE

3. SILICA ANALYSER

4. DISSOLVED OXYGEN ANALYSER

5. LEVEL SWITCH (FLOAT ACTUATED)

6. LEVEL SWITCH (ELECTRODE TYPE)

7. LEVEL SWITCH (DISPLACED ACTUATED)

8. TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURES

9. LEVEL INDICATOR (FLOAT/ PULLEY TYPE)

10. LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE

11. BI-METALLIC TEMPERATURE GAUGE

SL. NO.	DESCRIPTION
12.	RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE
13.	THERMOCOUPLE ELEMENT AND CONNECTING CABLE
14.	THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/ TRANSMITTER INCLUIDNG TEST PROCEDURES
15.	TEMPERATURE SWITCH INCLUDING TEST PROCEDURES
16.	COLD JUNCTION BOXES
17.	ZENER BARRIER
18.	O2 & FLUE GAS ANALYSER
19.	SMOKE DENSITY EQUIPMENT
20.	O2 IN HYDROGEN INCLUDING TEST PROCEDURES
21.	PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE
22.	DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE
23.	DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE
24.	FLOW INDICATOR (VARIABLE AREA)
25.	ORIFICE PLATE
26.	TURBINE FLOW TRANSMITTER
27.	FLOW SWITCH
28.	WEIR
29.	NOZZLE
30.	FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE
31.	FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE

SL. NO.	DESCRIPTION
32.	FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE
33.	VENTURI (FLUID)
34.	FLOW SWITCH (MAGNETIC TYPE)
35.	AVERAGING INLET
36.	LIMIT SWITCHES
37.	TURBINE SUPERVISORY MEASURING SYSTEM
38.	POSITION MEASUREMENT & INDICATION INCLUDING TEST PROCEDURES
39.	TACHOMETER
40.	VIBRATION MEASUREMENT
41.	DIGITAL INDICATOR
42.	MOVING COIL INDICATOR INCLUDING TEST PROCEDURE
43.	RECORDER (PNEUMATIC INLET) INCLUDING TEST PROCEDURE
44.	RECORDER INCLUDING TEST PROCEDURE
45.	FLAME SCANNER
46.	ELECTRICAL AUTO MANUAL CONTROL STATION
47.	PUSH BUTTON MODULE
48.	ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PROCEDURE
49.	TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS
50.	PNEUMATIC CONTROLLER/ INDICATOR INCLUDING TEST PROCEDURE

SL. NO.	DESCRIPTION
51.	PNEUMATIC LEVEL CONTROLLER
52.	THERMO CONTROL VALVE
53.	TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER-PID TERMS
54.	ELECTRONIC CONTROLLER (SELF CONTAINED) INCLUDING TEST
55.	TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT & PNEUMATIC OUTPUT

PRECOMMISSIONING AND COMMISSIONING OF FACILITIES

COMMISSIONING PROCEDURE/ TESTING SCHEDULE REQUIRING APPROVAL OF THE EMPLOYER

SL. NO.	DESCRIPTION
A.	OPEN CYCLE
1.	Hydraulic Test Procedures for
	(a) Gas Pipelines
2.	Cleaning / Flushing Proecedure for
	(a) Gas Pipelines
3.	Gas Flaring procedure
4.	Hydraulic test procedure for Lub / Lift / Control Oil system of Gas Turbine
5.	Oil Flushing of Lub/ Lift/ Control Oil system of Gas Turbine
6.	Chemical Cleaning of Lub/ Lift/ Control Oil system of GT
7.	Generator Testing procedure for First synchronization
8.	Seal Oil and Stator water system (if applicable)
B.	COMBINED CYCLE
1.	HRSG HYDRAULIC TEST AND PRESERVATION PROCEDURE
2.	AIR AND GAS TIGHTNESS TEST OF HRSG AND ASSOCIATED DUCTS
3.	HRSG CHEMICAL CLEANING
4.	STEAM BLOWING OF HRSG INCLUDING INTERCONNECTING PIPE LINES AND STEAM SUPPLY LINES

PRECOMMISSIONING AND COMMISSIONING OF FACILITIES

COMMISSIONING PROCEDURE/ TESTING SCHEDULE REQUIRING APPROVAL OF THE EMPLOYER STEAM TURBINE & GENERATOR

SL. NO.	DESCRIPTION
1.	HYDRAULIC TEST PROCEUDRE FOR
	A. LUB OIL SYSTEM
	B. CONTROL OIL & JACKING OIL SYSTEM
	C. SEAL OIL SYSTEM
	D. WATER SYSTEM
2.	OIL FLUSHING OF LUB OIL SYSTEM
3.	OIL FLUSHING OF CONTROL & JACKING OIL SYSTEM
4.	OIL FLUSHING OF GENERATOR SEAL OIL SYSTEM
5.	STATOR WATER FLUSHING
6.	ALKALI FLUSHING FOR PRE-BOILER & CONDENSATE SYSTEM
7.	HP/ LP BYPASS SYSTEM
8.	AIR TIGHTNESS TEST OF GENERATOR
9.	CONDENSER FLOOD TEST
10.	CONDENSER VACUUM TIGHTNESS TEST
11.	STEAM BLOWING OF GLAND SEAL PIPE LINES, AUX. STEAM PIPELINE
12.	GENERATOR TESTING, PROCEDURE FOR FIRST SYNCHONIZATION

ANNEXURE-IV
PAGE 1/1

BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULES

TESTING SCHEDULES SHOULD BE DESIGNED TO ENSURE THAT THE PLANT AREA, EQUIPMENT OR APPRATUS ARE TESTED AND COMMISSIONED AND WILL OPERATE AS PER THE EMPLOYER'S SPECIFICATIONS AND GOOD ENGINEERING PRACTICES.

TESTING SCHEDULE IS REQUIRED TO BE OF A STANDARD FORMAT IN ORDER TO MAINTAIN CONSISTENCY OF PRESENTATION, CONTENT AND REPORTING

THE TESTING SCHEDULES SHOULD CONTAIN THE FOLLOWING SECTIONS TO MAKE THE DOCUMENT A SELF CONTAINED ONE:

1. PLANT DETAILS/ DESIGN DATA

2. TESTING OBJECTIVE/ PROPOSALS

3. STATE OF THE PLANT

A. ERECTION STATUS WITH RESPECT TO MECH., ELECT. AND C&I

B. AVAILABILITY OF THE SERVICES REQUIRED

C. SAFETY REQUIREMENTS AS PER MANUFACTURER'S RECOMMENDATIONS

4. TEST METHOD INCLUDING COMPLETION/ ACCEPTANCE CRITERIA

5. RESULTS

6. APPENDIX

A. TESTING PROGRAMME

B. MECH./ ELECT./ C&I —— PLANT ITEM COMPLETION LIST

C. LIST OF DRAWINGS/ DOCUMENTS REQUIRED FOR CARRYING OUT THE TESTING

ANNEXURE-VI

CERTIFICATE OF DECLARATION FOR CONFIRMING THE KNOWLEDGE OF SITE CONDITIONS

We,…… ……. Hereby declare and confirm that we have visited the project site under the subject namely, ……and acquired full knowledge and information about the ***site conditions, wage structure, Industrial climate and total work involved***. We further confirm that the above information is true and correct and we will not raise any claim of any nature due to lack of knowledge of site condition.

Tenderers Name and Address

Place: (Signature of the Tenderer with stamp)

Date:

ANNEXURE-VII

NON DISCLOSURE AGREEMENT
Memorandum of Understanding

BHEL PSNR is committed to Information Security Management System as per Information Security Policy.

M/s……, providing……..service to BHEL PSNR, Noida hereby undertake to comply with the following in line with Information Security Policy of BHEL PSNR;

- To maintain confidentiality of documents & information which shall be used during the execution of the Contract.
- The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHEL PSNR.

( )	( )
M/s. BHEL, PSNR	M/s……..

GENERAL TERMS AND CONDITIONS OF REVERSE AUCTION (RA)

Against this enquiry for the subject item/ system with detailed scope of supply as per our tender specification, BHEL-PSNR, NOIDA may resort to "REVERSE AUCTION PROCEDURE" i.e. **ONLINE BIDDING on INTERNET.**

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on Internet.
3. BHEL will inform the vendor in writing in case reverse auction, the details of service provider to enable them to contact and get trained.
4. Business rules like event date, time, start price, bid decrement, extensions, etc. also will be communicated through service provider for compliance.
5. Vendors have to fax the compliance form in the prescribed (provided by service provider) before start of Reverse auction. Without this the vendor will not be eligible to participate in the event.
6. BHEL will provide the calculation sheet (e.g.: EXCEL sheet) which will help to arrive at "Total Cost to BHEL" like packing & forwarding charges, Taxes and duties, Freight charges, Insurance, Service tax for services and loading factors (for non-compliance to BHEL standard Commercial terms and conditions.) for each the vendor to enable them to fill-in the price and keep it ready for keying in during the auction.
7. Reverse auction will be conducted on schedule date & time.
8. At the end of reverse auction event, the lowest bidder value will be known on the network.
9. The lowest bidder has to fax the duly signed filled-in prescribed format as provided on case-to-case basis to BHEL through service provider within 24 hours of auction without fail.
10. Any variation between the on-line bid value and signed document will be considered as sabotaging the tender process and will invite disqualification of vender to conduct business with BHEL as per prevailing procedure.
11. In case BHEL decides not to go for Reverse auction procedure for this tender enquiry, the price bids and price impacts, if any already submitted and available with BHEL shall be opened as per BHEL standard practice.

ANNEXURE - IX

FORMAT FOR NO DEVIATION CERTIFICATE

(To be submitted in the bidder's letter head)

Bharat Heavy Electricals Limited
Power Sector – Northren Region,
Plot No. 25 , Sector - 16A ,
Distt. Gautam Budh Nagar,
NOIDA – 201 301. INDIA

Sub.: No Deviation Certificate for the work of "Erection, Testing, Commissioning, Trial Operation and Handing over of 4 x 272 TPH HRSG with related auxiliaries & piping at 1500 MW Pragati-III CCPP at Bawana, Delhi"

TENDER NO. BHEL: NR (SCT): BAWANA: HRSG: 604

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed / modified the tender documents as appeared in the website and in case of observance at any stage; it shall be treated as null and void. We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT and confirm our acceptance to reverse auctioning process and we hereby convey our unqualified acceptance to all terms and conditions as stipulated in the tender and NIT. In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer strictly in accordance with tender instructions.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)