



एचपीसीएल बायोफ्यूल्स लिमिटेड

(हिन्दुस्तान पेट्रोलियम कॉर्पोरेशन लिमिटेड के पूर्ण स्वामित्व वाली सहायक कम्पनी)

HPCL BIOFUELS LIMITED

(A wholly owned subsidiary company of Hindustan Petroleum Corporation Ltd.)

पंजीकृत कार्यालय : प्रथम मंजिल, श्री सदन, प्लॉट न. 09, पाटलीपुत्र कॉलोनी, पटना-800013, बिहार

Regd. Office : 1st Floor, Shree Sadan, Plot No.09, Patliputra Colony, Patna-800013, Bihar

दूरभाष / Telephone : 0612 - 2260185 / 2270483, Website : www.hpclbiofuels.co.in, CIN - U24290BR2009GOI014927

TENDER ENQUIRY (Unpriced BID)

तकनीकी बीड

(This is only a Price Enquiry not a Purchase Order)

From: (Name & Address to be written below by the tenderer)

To,

M/s _____

Tender No: HBL/TEN/PUB/20-21/223

Tender Date: 06.02.2021

Direct Queries Related to Sugauli

To: ABHISHEK KUMAR SINGH

Designation: PROJECT- ENGINEER

Mobile No:- +917277705022

Title : Bid for the supply, delivery, installation and commissioning of the goods, materials and equipment for 22 TPH Incineration boiler & Aux. along with Balance of Plant including F&AH, DCS etc for their proposed Incineration boiler based cogen power plant at village Sugauli, East Champaran, Bihar on Engineering, Procurement and Commissioning basis.

Tender (Technical & unpriced commercial bid and priced bid) to be received on or before 05/03/2021 by 1430 Hrs at the address mentioned below.

Tenders are to be dropped in the designated tender box at the address mentioned below. In situation where the tenders are big which cannot be dropped in the box or where the specific tender boxes are not available, tenders are to be submitted with the concerned purchasing authority at the following address.

**HPCL Biofuels Limited.
1St Floor, Shree Sadan,
Plot No. 09, Patliputra Colony,
Patna, Bihar - 800013.**

Tender received after due date and time due to whatever reasons will be rejected.

Signature and Seal of the Bidder

HBL/TEN/PUB/20-21/223 dated 06.02.2021

Page 1 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

1. For any grievance related issue, queries to be sent to Grievance Redressal cell of HPCL Biofuels Limited (HBL) at above address.
2. All unit rates in **Indian Rupees** (Specify currency)

Prebid meeting for above EPC Package will be held on February 17, 2021, 11:30 am at MITCON Pune Office, following address:

MITCON Consultancy & Engineering Services Ltd
Kubera Chamber, Shivajinagar,
Pune, Maharashtra 411005

TABLE OF CONTENTS

SECTION I- COMMERCIAL EPC BID FOR INCINERATION BOILER WITH BOP

CHAPTER	SUBJECT	PAGE NO.
I.	INSTRUCTIONS TO BIDDERS	07
II.	TERMS & CONDITIONS FOR THE SUPPLY CONTRACT	18
III.	TERMS & CONDITIONS FOR THE ERECTION & COMMISSIONING SERVICES CONTRACT	46
IV.	PROJECT INFORMATION	67
V	ANNEXURES	69
A.	BANK GUARANTEE FORMAT	69
B.	PROFORMA FOR PERFORMANCE STATEMENT	72

LIST OF APPENDICES

APPENDIX NO.	NAME	PAGE NO
I	BID FORM & PRICE SCHEDULE	73
II	PAYMENT SCHEDULE	77
III	NO DEVIATION LETTER	79
IV	PENALTY FOR SHORTFALL IN PERFORMANCE	80

SECTION II- TECHNICAL EPC BID FOR INCINERATION BOILER WITH BOP

CHAPTER – 1	82
DESIGN BASIS, SCOPE OF WORK AND TERMINAL POINTS	82
1.1 GENERAL.....	82
1.2 AMBIENT CONDITIONS	82
1.3 FUELS	83
1.4 PLANT DESIGN CRITERIA.....	84
1.5 MAIN PLANT AND EQUIPMENTS.....	85
1.6 SCOPE OF WORK	101
1.7 TERMINAL POINTS	102
CHAPTER – 2.....	104
TECHNICAL SPECIFICATIONS FOR MECHANICAL & ELECTRICAL EQUIPMENTS, INSTRUMENTATION & CONTROL AND ERECTION & COMMISSIONING.....	104
2.1 STEAM GENERATOR & AUXILIARIES	104
2.2 STEAM GENERATOR TECHNICAL PARAMETERS.....	105
2.3 STEAM DRUMS	105
2.4 STEAM GENERATOR TUBES	106
2.5 STEAM GENERATOR HEADERS	107
2.6 EVAPORATOR BANK.....	107
2.7 SUPER HEATERS & SUPERHEATED STEAM HEADER	107
2.8 FURNACE.....	109
2.9 FUEL FIRING SYSTEM	109
2.10 ECONOMISER	111
2.11 AIR PRE-HEATER	112
2.12 ELECTRO STATIC PRECIPITATOR (ESP) / BAG FILTER	112
2.13 INDUCED DRAUGHT FAN	113
2.14 FORCED DRAUGHT FAN.....	114
2.15 PERFORMANCE REQUIREMENTS FOR FANS.....	115
2.16 SECONDARY AIR FANS	115
2.17 BLOW DOWN ARRANGEMENTS.....	116
2.18 SOOT BLOWING EQUIPMENT	116
2.19 DE-AERATOR & DEAERATED WATER STORAGE TANK AND CONDENSATE STORAGE TANK.....	117
2.20 BOILER FEED WATER PUMPS.....	118
2.21 INSTRUMENTATION.....	119
2.22 ELECTRICAL	126
2.23 MATERIAL OF CONSTRUCTION, GENERAL INSTRUCTIONS AND SCOPE OF PIPING	128
2.24 STEAM TURBINE GENERATOR & AUXILIARIES	138
2.25 AIR COMPRESSOR & DRYER	141
2.26 FUEL & ASH HANDLING SYSTEM	143
2.27 COOLING TOWER, CW PUMPS AND CW PIPING	153
2.28 PIPING AND FITTINGS.....	156
2.29 PAINTING.....	161
2.30 VFD UNITS.....	162
2.31 DCS BASED INSTRUMENTATION & CONTROL	164
2.32 FIRE FIGHTING SYSTEM.....	194
2.33 SPECIFICATION FOR ERECTION OF MECHANICAL EQUIPMENT	197
2.34 SPECIFICATION FOR ERECTION OF ELECTRICAL EQUIPMENTS	201
2.35 ERECTION & COMMISSIONING FOR DCS	206
CHAPTER – 3.....	208

INPUTS FOR CIVIL & STRUCTURAL CONSTRUCTIONS.....	208
3.1 MAJOR CIVIL WORKS	208
CHAPTER – 4.....	209
APPROVED LIST OF VENDORS, LIST OF SPARES AND LIST OF DRAWINGS/ DOCUMENTS	209
4.1 APPROVED LIST OF VENDORS.....	209
4.2 LIST OF SPARES.....	213
4.3 LIST OF DRAWINGS & DOCUMENTS	218
CHAPTER – 5.....	225
DATA SHEETS	225
5.1 STEAM GENERATOR & AUXILIARIES	225
5.2 BALANCE PUMPS.....	228
5.3 PERFORMANCE GUARANTEE.....	228
5.4 LIST OF TECHNICAL DEVIATIONS, IF ANY	229

LIST OF APPENDICES

APPENDI X NO.	APPENDICES	PAGE NO
I	Proposed Master Plan	230
II	Typical Schematics System Configuration, Plant DCS	231
III	Piping & Welding Procedure	232
IV	Codes & Standards	254
V	Typical Painting Summary	262
VI	Electrical System Requirements For Motor Selection	271
VII	Specifications For Insulation And Refractory	273

SECTION I- COMMERCIAL EPC BID FOR INCINERATION BOILER WITH BOP

I. INSTRUCTION TO BIDDERS

1. Scope

- 1.1 M/s **HPCL Biofuels Ltd, Sugauli** (hereinafter referred to as the **PURCHASER**) wishes to receive the Bid for the supply, delivery, installation and commissioning of the goods, materials and equipment (such goods, materials and equipment hereinafter referred to as the goods) for Incineration boiler & Aux. along with Balance of Plant including F&AH, DCS etc for their proposed Incineration boiler based cogen power plant at village Sugauli, East Champaran, Bihar on Engineering, Procurement and Commissioning basis.

Also, Purchaser wish to receive technical & operation support assistance for two years for the above EPC project. For two years and above, it will be based on **PURCHASER** prorogation. Also, Bidder to deploy one technical manpower (either from bidder or OEM) after warranty period, to ensure smooth operation of the above plant. Within warranty period, it will be bidder's responsibility.

In addition to the deployment of OEMs/ Bidders Engineer to ensure Guarantee run for 2 years post commissioning, the bidder shall also provide technical, operational and troubleshooting support to the Purchaser, post commissioning for 2 years. One expert should be sent at site on call (within 3 days from the date of communication). Bidder to provide the man-day rates. This man day rate to be indicated separately in the Price Schedule. This shall be considered in the evaluation. (The boarding and travel expenses shall be provided by the Purchaser)

- 1.2 All bids are to be completed and returned to the **PURCHASER** in accordance with these instructions to **BIDDERS**.
- 1.3 Before submitting the offer, the **BIDDERS** are advised to inspect the site and the environment and be well acquainted with the actual working and other prevalent conditions, facilities available, position of material and labour. No claim will be entertained later on the ground of lack of knowledge.

2. Cost of bidding

- 2.1 The **BIDDER** shall bear all costs associated with the preparation of the bid. **PURCHASER / CONSULTANT** will, in no case, be responsible or liable for such costs, regardless of the conduct or outcome of the bidding process.

3. Joint Ventures

- 3.1 In the event that the successful **BIDDER** is a joint venture formed of two or more companies, the **PURCHASER** requires that the parties to the joint venture accept liability jointly and severally for all obligations under the contract.

4. Assurance

The successful **BIDDER** will be required to give satisfactory assurance of its ability and intention to supply the goods and services pursuant to the contract, within the time set forth therein.

5. Bidding Documents

- 5.1 The required goods and services, bidding procedures and contract terms are prescribed in this volume I of the bidding documents. The volume II of the bidding documents gives the technical specification, data sheets and the drawings according to which the equipment is to be designed, manufactured and erected. The Appendix I in volume - I of the bidding documents gives bid form and price schedule to be filled up and submitted along with the offer by the Supplier.
- 5.2 BIDDERS shall carefully study all sections of these bidding documents and shall clearly indicate in the schedule of deviations, all deviations from technical specification as well as those from general terms and conditions. If no deviation is indicated in the schedule of deviations or except for the deviations indicated, it will be understood that in all other aspects, the offer conforms to the specification and the PURCHASER reserves the right to evaluate the bid as such without any further reference to the BIDDER.
- 5.3 If the **BIDDER** indicates any comment on this specification in their bid, the same will not be accepted. No extra claims on account of the lack of understanding of the clauses/articles on the part of the **BIDDER** will be entertained by the **PURCHASER** after the award of contract.
- 5.4 BIDDERS shall furnish all the data/information called for in the various schedules in Volume II, more specifically the provided data sheets in soft and hard versions failing which the bid will be considered as incomplete and non-responsive and the PURCHASER reserves the right to reject the bid.

6 Clarification on bidding documents

- 6.1 In case, any clarification is required, the **BIDDER** shall obtain the same from the **PURCHASER/CONSULTANT** in writing by E-mail so as to ensure submission of bid on or before the bid closing date. All such clarifications shall be binding both on the **PURCHASER** and the **BIDDERS**.
- 6.2 All communications seeking clarification shall be sent to the **CONSULTANTS with copy to PURCHASER**.
- 6.3 Written copies of the **PURCHASER's/ CONSULTANT's** response (including an explanation of the query, but without identifying the source of the enquiry) will be sent to all prospective **BIDDERS** who have been issued the bid documents.

7. Amendment of Bidding Documents

- 7.1 At any time prior to the deadline for submission of bid, the **PURCHASER** may, for any reason, whether at their own initiative or in response to a clarification requested by a prospective **BIDDER**, modify the bidding documents by amendment through corrigendum which will be hosted on the HBL Website
- 7.2 The amendment shall be part of the bidding documents and will be notified in writing or by E-Mail to all prospective **BIDDERS** who have received the bidding documents, and will be binding on them. **BIDDERS** will be required to acknowledge receipt of any such amendment to the

bidding documents.

- 7.3 In order to afford prospective **BIDDERS** reasonable time in which to take the amendment into account in preparing their bid, the **PURCHASER** may, at their discretion, extend the deadline for the submission of bid.

8. Language of the bid

The bid prepared by the **BIDDER** and all correspondence and documents relating to the bid exchanged by the **BIDDER** and **PURCHASER/CONSULTANT**, shall be written in the English language, provided that any printed literature furnished by the **BIDDER** though written in another language, shall be accompanied by an English translation in which case, for purpose of interpretation of the bid, the English translation shall govern.

9 Qualification of BIDDERS

- 9.1 Only **BIDDERS** who have previous experience in the work of this nature and description detailed in this tender specification are expected to quote for this work, duly detailing their experience along with the offer. Offers from **BIDDERS** who do not have proven and established experience in the field are not likely to be considered.
- 9.2 The documentary evidence of the **BIDDER's** qualifications to perform the contract if the bid is accepted shall be established to the **PURCHASER's** satisfaction.
- 9.3 In the case of a **BIDDER** offering to supply goods under the contract which the **BIDDER** does not manufacture, the **BIDDER** shall have been duly authorized by the good's manufacturer, to supply and service the goods in India.
- 9.4 In the case of a **BIDDER** where a collaborator is associated with this bid, the bid shall be accompanied by a document addressed to the **PURCHASER** and signed by the collaborator declaring the collaboration agreement.
- 9.5 In addition to the above, to be eligible for the award of the contract, all of the following basic criteria shall be fulfilled. Performance of such installations shall be satisfactory and necessary documentary evidence to prove this shall be submitted along with the bid.
- 9.5.1 The **BIDDERS** should have designed, engineered, supplied, erected and commissioned minimum of two (2) complete Incineration boiler project 20TPH or above capacity and the same projects should be in satisfactory operation for a minimum period of two (2) years.

10. Previous Experience

- 10.1 A statement giving particulars, duly supported by documentary evidence of the various services rendered for similar work by the **BIDDER** indicating the particulars and value of each work, the site location and the duration and date of completion and also such work that are under progress shall be submitted by the **BIDDERS** along with their offers.
- 10.2 Bidder to submit duly signed original completion certificate from principal client for similar job, work order contract copy and payment proof from the Principal client for establishing credentials of the party.

11 Documents Comprising the Bid

11.1 The bid prepared by the **BIDDER** shall comprise of the following:

- a) Completed bid form and with complete technical details including the data sheets and all schedules completed in accordance with the requirement of volumes - I and II.
- b) Documentary evidence established to the requirement of the relevant clause that the **BIDDER** is qualified to perform the contract if the bid is accepted.

11.2 The bid prepared by the **BIDDER** shall be in Three (3) parts.

Part - I -Technical & Unpriced Commercial Bid

Part - II -Price Bid

Part III- EMD

11.3 PART - I -TECHNICAL & UNPRICED COMMERCIAL BID

Technical bid shall indicate the following to the extent applicable:

- a) **BIDDER's** confirmation that the goods and ancillary services to be supplied by the **BIDDER** conform to the bidding documents.
- b) Complete scope of supply supported by documents, brochures, standards, catalogue etc. as applicable.
- c) List of spare parts for the erection and commissioning of all systems and equipment.
- d) List of spare parts for operation and maintenance,
- e) List of maintenance tools and tackles.
- f) Layout drawings and sketches with dimensions of equipment and indicating limits of supply.
- g) Nature of maintenance assistance available / offered by **BIDDER**.
- h) Delivery schedule and place of manufacture.
- i) Reference list of customers using similar equipment and materials.
- j) Complete filled up data sheets (to be submitted in given format in word / excel soft copy on provided email id's),
- k) Training facilities offered.

Unpriced Commercial Bid shall indicate the following:

- a) Terms of Payment as per tender.
- b) Confirmation that firm prices have been quoted.
- c) Port/place of shipment.

- d) Statement that all taxes and duties levied by the exporting country, if any are included.
- e) Acceptance of general terms and conditions of the purchase.
- f) Confirmation that validity of bid for 90-days and 120-days for spares from the price bid opening date.
- g) Information requested under Clause - 9.
- h) No deviation letter.

11.4 PART - II -PRICE BID

Should cover the bid price and other related costs, in the provided format.

11.5 PART – III- EMD

EARNEST MONEY DEPOSIT (EMD) of **Rs 22, 00,000** in form of account payee crossed Demand Draft, drawn in favor of HPCL Biofuels Ltd. payable at Patna of any schedule bank (Co-operative not acceptable). Tender without the valid EMD, will not be considered for evaluation. SSI/NSIC/MSME registered vendor shall be exempted from EMD. However, vendor has to submit/enclosed the supporting documents

12 Price and Rates

- 12.1 The price to be quoted by the **BIDDERS** shall be in Indian rupees and the quotation shall be in accordance with the requirement of the relevant schedules in the bid specification. The price shall be separately for basic price, taxes and duties as called for elsewhere in this specification.
- 12.2 The prices quoted shall be for complete supply, inspection, packing and forwarding, freight and transit insurance, port clearances, statutory fees payable, unloading at site, erection, commissioning and testing of equipment which will include all the required procurement and allied activities for completion of the job in all aspect and handing over the same to the **PURCHASER**.
- 12.3 Indigenous **BIDDERS** shall arrange for their own required licenses and foreign exchange, if imported components are considered in the equipment supply.

13 Validity and Firm Price

- 13.1 The prices quoted by the **BIDDERS** shall be kept open and valid for acceptance for a minimum period of ninety (90) days from the date of opening of the offers. The quotation shall be for the entire scope of work on the '**FIRM PRICE**' basis. No escalation whatsoever is acceptable. The quotations not on the basis of '**FIRM PRICE**' will be treated as non-responsive and they run the risk of rejection.
- 13.2 Prices shall be written in both words and figures. In the event of difference, the prices in words shall be valid and binding. Unit prices shall be considered correct in the event of any discrepancy with regard to the total price.

14. Format and Signing of Bid

- 14.1 The original bid form and accompanying documents clearly marked “Original”, must be received by the **PURCHASER / CONSULTANT** at the date, time and place specified, pursuant to

Signature and Seal of the Bidder **HBL/TEN/PUB/20-21/223 dated 06.02.2021** Page 11 | 278

clauses-15 and 16. In the event of any discrepancy between the original and the copies, the original shall govern.

- 14.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by the **BIDDER** or a person or persons duly authorized to sign on behalf of the **BIDDER**. Such authorization shall be indicated by written power-of-attorney accompanying the bid.

All pages of the bid, except for unamended printed literature, shall be initialed by the person or persons signing the bid. The name and position held by each person signing must be typed or printed below the signature.

The bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors and such corrections shall be initialed by the person or persons signing the bid.

15 Sealing and Marking of Bid

- 15.1 The **BIDDERS** are requested to prepare their offers in one (1) original and one (1) copy and shall submit in 2 sealed envelopes to the Purchaser's address.

One additional copy of the technical & unpriced commercial bid shall be addressed to the Consultant and submit at the Consultant's email address (in soft copy format only) as given in project information.

15.1.1 **The first envelope** should contain three (3) sets (One original and two copies) of technical bid and two (2) sets (One original and one copy) of unpriced commercial bid, no deviation letter, and documents for eligibility. This envelope should be clearly marked **"Technical & Unpriced Commercial Bid"** and shall be addressed to the **PURCHASER at the address given in project information (both soft & hard copy)**

15.1.2 **The second envelope** should contain one original copy of price bid and should be clearly marked as **"PRICE BID"** and shall be addressed to the registered / site office of **PURCHASER only (hard copy only)**

15.1.3 **The third envelope** should contain **Original EMD of Rs 22 Lakhs** in form of account payee crossed Demand Draft, drawn in favor of HPCL Biofuels Ltd. payable at Patna of any schedule bank (Co-operative not acceptable). It should be clearly marked as **"EMD"** and shall be addressed to the registered / site office of **PURCHASER only (Hard copy only)**

15.1.4 All the envelopes shall bear the title, "Incineration boiler & Aux. with BoP, Project enquiry number, bid closing date and brief description of the contents".

15.1.5 The name and address of the **BIDDER** shall be clearly marked on the envelope to enable the bid to be returned unopened in case it is declared "late".

- 15.2 If the envelopes are not sealed and marked as required in this clause, as the case may be, the PURCHASER will assume no responsibility for the bid's misplacement or premature opening.

16 Deadline for Submission of Bid

- 16.1 **The original TECHNICAL & UNPRICED COMMERCIAL BID and PRICE BID with EMD** together with the required copies, must be received by the **PURCHASER**, not later than

March 5, 2021, 14.30 Hrs. Also, soft copy (word or excel file) of duly filled technical data sheets to be submitted on the given email id of Consultant / Purchaser within informed time limit.

16.2 The **PURCHASER** may, at their discretion, extend the deadline for the submission of bid by amending the bidding documents, in which case all rights and obligations of the **PURCHASER** and **BIDDERS** previously subject to the deadline will thereafter be subject to the deadline as extended.

17. Late Bid

Any bid received by the **PURCHASER** after the deadline for submission of bid so prescribed by the **PURCHASER**, shall be declared “late”.

18 Modification and Withdrawal of Bid

18.1 The **BIDDER** may modify or withdraw the bid after submission of bid, provided that written notice of the modification or withdrawal is received by the **PURCHASER** prior to the deadline prescribed for submission of bid.

18.2 The **BIDDER's** modification or withdrawal notice shall be prepared, sealed, marked and dispatched in accordance with the provisions of clause-15. A withdrawal notice may also be sent by E-mail but must be followed by a signed confirmation copy.

18.3 No bid shall be modified subsequent to the deadline for submission of bid.

18.4 No bid shall be withdrawn in the interval between the deadline for submission of bid and the expiration of the period of bid validity specified by the **BIDDER** on the bid form.

19. Acceptance / rejection of quotation

19.1 The acceptance / rejection of the bid will rest with the **PURCHASER** who do not bind themselves to accept the lowest bid or any bid and reserve to themselves the full rights for the following without assigning any reason whatsoever.

- To reject any or all of the bids.
- To split up the work amongst two or more **BIDDERS**.
- To award the work in part.

19.2 Conditional and unsigned bids, bids containing absurd or unworkable prices bids which are incomplete and otherwise considered defective and bids not in accordance with the tender conditions and specification, etc., are all liable to be rejected.

19.3 If a bidder quits business after the submission of the bid or after the acceptance of their bid, the **PURCHASER** may at their discretion reject such bid. If a partner of a firm exists from business after the submission of the bid or after acceptance of the bid, the **PURCHASER** may cancel such a bid at their discretion unless the firm retains its character.

19.4 The successful **BIDDER** should not sub-contract a part of the complete work undertaken by

them without written permission from **PURCHASER**. The **BIDDER** on whom the contract is awarded is solely responsible to the **PURCHASER** for the completion of the awarded work.

20. Opening of the price Bids by Purchaser

- 20.1 The technical bids will be evaluated with regard to the PQC, scope, terminal points, exclusions and the general technical specifications of all the equipment to be supplied by the **BIDDER** and the qualification of the **BIDDER** to execute the job.
- 20.2 Subsequent to the technical evaluation, the **PURCHASER** will inform the qualified **BIDDERS** to attend the opening of **Price Bids in the presence of BIDDER's representatives who choose to attend. The venue will be informed at later stage.**

21. Process to be confidential

- 21.1 Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for award of contract shall not be disclosed to the **BIDDERS** or any other persons not officially concerned with such process. Any effort by a **BIDDER** to influence a **PURCHASER's** processing of bids or award decisions may result in the rejection of the **BIDDER's** bid.

22. Clarification of Bid

- 22.1 To assist in the examination, evaluation and comparison of bid, the **PURCHASER/CONSULTANT** may at their discretion, ask the **BIDDER** for a clarification of their bid. All responses to request for clarification shall be in writing and no change in the price or substance of the bid shall be sought, offered or permitted.

23. Preliminary Examination

- 23.1 The **PURCHASER** will examine the bid to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed, and whether the bids are generally in order.
- 23.2 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total cost will be corrected. If there is a discrepancy between the total bid amount and the sum of total costs, the total cost shall prevail and the total bid amount will be corrected.
- 23.3 Prior to the detailed evaluation, pursuant to clause-23, the **PURCHASER** will determine the substantial responsiveness of each bid to the bidding documents. A substantially responsive bid is one which conforms to all the terms and conditions of the bidding documents without deviation.
- 23.4 A bid determined as not substantially responsive will be rejected by the **PURCHASER** and may not subsequently be made responsive by the **BIDDER** by correction of the non-conformity.

24 Conversion to Single Currency

- 24.1 To facilitate evaluation and comparison, all the bid prices in the various currencies, shall be converted to Indian rupees, at the selling exchange rate established by the Reserve Bank of India for similar transactions, on the date of opening of the price bid to be decided by the **PURCHASER/CONSULTANT**.

25 Evaluation and Comparison of Bid

25.1 The **PURCHASER** will evaluate and compare the bid previously determined to be substantially responsive.

25.2 The **PURCHASER**'s evaluation of a bid will take into account, in addition to the bid price, the following factors, in the manner and extent indicated below:

(a) Work schedule offered in the bid;
The **PURCHASER** requires that the goods under the contract shall be delivered, erected and commissioned within twelve (12) months from the date of notification of award. No credit will be given to earlier deliveries.

Bid offering delivery, erection and commissioning more than twelve (12) months will be rejected.

(b). Deviations in payment schedule from those specified in the conditions of the contract.

25.3 The **PURCHASER / CONSULTANT**'s evaluation shall also take into account the following:

a) **BIDDER**'s experience in manufacturing and supply of similar plants for the intended service on the basis of information provided by **BIDDER**. Incineration Boiler & Aux. with BoP project of similar or larger scope to that required by technical specification should have been in operation satisfactorily for a minimum period of two years in Sugars plant installation for project completed within the previous five years. Bid not fulfilling this requirement will not be considered technically acceptable.

b) Availability in India of spare parts and "after-sale service" for the equipment offered in the bid, for minimum 3 sugar seasons.

c) The quality and adaptability of equipment offered.

d) **BIDDER**'s guarantees nature of warranties and warranty period.

e) Willingness to give shop drawings of spare parts and main equipment. –

f) Confirmation from the sub-vendors that for future supply of spare parts for bought out items, the sub-vendors shall supply such spares directly to the **PURCHASER** as and when **PURCHASER** so requests.

26. Notification of Award

26.1 Prior to the expiration of the period of bid validity, the **PURCHASER** will notify the successful **BIDDER** by E-mail to be confirmed by letter that their bid has been accepted and this "notification of award" as above will constitute formation of contract".

26.2 The successful **BIDDER** on receipt of "notification of award" shall convey his acceptance by return E-mail and to be confirmed by letter within 7-days.

26.3 Delivery shall be counted from the date of receipt of this "notification of award".

Signature and Seal of the Bidder **HBL/TEN/PUB/20-21/223 dated 06.02.2021** Page 15 | 278

27. Award of contract and purchaser's right to vary quantities at the time of award.

- 27.1 The **PURCHASER** will award the contract to the successful **BIDDER** whose bid has been determined to be substantially most responsive after the final negotiations held with the most competitive **BIDDERS**.
- 27.2 Wherever applicable, the **PURCHASER** reserves the right at the time of award of the contract to increase or decrease by upto 40% the quantity of goods and services without any change in unit price or other terms and conditions.
- 27.3 Under possible circumstances, the **PURCHASER** reserves the right to split the contract which may result from this enquiry, between two or more **BIDDERS** at the prices accepted.

28. Signing of contract

- 28.1 **PURCHASER** will send the contract to the successful **BIDDER** who, within seven (7) days of its receipt, shall countersign and return it to the **PURCHASER** as a token of unconditional acceptance failing which, the **PURCHASER** has the right to cancel / withdraw the contract.

29 Exceptions

- 29.1 As far as possible, no exception is to be taken by the **BIDDER** to the bid documents including technical specification and terms and conditions of contract. However, unavoidable exceptions, if any, both technical and commercial, are required to be listed and submitted separately, including the applicable cost and time implications. Such exceptions giving the cost implications should be separately enclosed in the priced commercial bid and exceptions should be clearly stated in the unpriced commercial bid with a statement that cost implications have been given in the priced commercial bid. Time schedule implications of exceptions should be given in the unpriced commercial bid. Unless the exceptions are listed separately as explained above, it will be assumed by the **PURCHASER** that **BIDDER** is complying with the bid documents, and no cognizance shall be taken of any exception stated anywhere else in the bid.

30 Verification by purchaser

- 30.1 All statements submitted by **BIDDER** regarding experience, manpower availability, equipment and machinery availability etc., are subject to verification by the **PURCHASER** either before placement of order or after placement of order. If any data submitted by the contractor at the bid stage is found to be incorrect, the offer is liable to be rejected or the contract is liable to be terminated.

31 Life Cycle

Bidder will need to confirm that the design practices followed will result in life cycle of 25 years or above of the specified Incineration boiler & auxiliary with BoP subject to normal wear and tear and regular O&M practices as recommended by bidder.

32 Estimated Cleaning Cycle

Bidder will need to confirm estimated cleaning cycle for Incineration Boiler in submitted techno-commercial bid

IMPORTANT

THE OFFER SHALL BE BASED ONLY ON THE TERMS AND CONDITIONS GIVEN IN THESE BID DOCUMENTS. THE BIDDERS ARE ADVISED TO PREPARE THE BIDS COMPLETELY IN LINE WITH THE TENDER REQUIREMENT WITHOUT ANY DEVIATIONS. IN CASE THE BIDDERS NEED ANY CLARIFICATIONS ON THE TENDER DOCUMENTS, THEY ARE ADVISED TO CONTACT THE PURCHASER & CONSULTANT OR GET THEIR POINTS CLARIFIED BEFORE THE SUBMISSION OF THE BIDS. THE OFFER OF ANY BIDDER GIVING THEIR OWN SEPARATE SET OF TECHNICAL AND COMMERCIAL TERMS AND CONDITIONS WILL BE CONSIDERED AS NONRESPONSIVE AND REJECTED.

BIDDERS SHOULD ENCLOSE THE PROFORMA FOR PERFORMANCE STATEMENT AS PER THE FORMAT GIVEN IN VOLUME-I, TO GET QUALIFIED

II. TERMS & CONDITIONS FOR THE SUPPLY CONTRACT

1. GENERAL CONDITIONS OF CONTRACT FOR SUPPLY

1.1 Use of Contract documents and information

- 1.1.1 The **SUPPLIER** shall not, without the **PURCHASER**'s prior written consent, disclose the contract, or any provision thereof, or any specification, drawing, pattern, sample or information furnished by or on behalf of the **PURCHASER** in connection therewith, to any person other than a person employed by the **SUPPLIER** in the performance of the contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purposes of such performance.
- 1.1.2 The **SUPPLIER** shall not, without the **PURCHASER**'s prior written consent, make use of any document or information specified in clause-1.1.1 above, except for purposes of performing the contract.
- 1.1.3 Any document other than the contract itself, specified in clause-1.1.1 above, shall remain to be the property of the **PURCHASER** and shall be returned (in all copies) to the **PURCHASER**, on completion of the **SUPPLIER**'s performance under the contract, if so required by the **PURCHASER**.

1.2 Change orders

- 1.2.1 The **PURCHASER** may at any time, by written notice to the **SUPPLIER**, make changes within the general scope of the contract.
- 1.2.2 Upon notification by the **PURCHASER** of such change, the **SUPPLIER** shall submit to the **PURCHASER** an estimate of costs for the proposed change (hereinafter referred to as the change or changes), including any change in the schedule of payments, within ten (10) calendar days of receipt of notice of the change, and shall include an estimate of the impact (if any) on the delivery dates under the contract, as well as a detailed schedule for the execution of the change, if applicable.
- 1.2.3 The **SUPPLIER** shall not effect changes in accordance with clause-1.2.1 above until the **PURCHASER** has authorized a change order in writing on the basis of the estimate provided by the **SUPPLIER** as described in clause-1.2.2 above.
- 1.2.4 Adjustments in the work schedule or the contract price authorized by a change pursuant to clause-1.2.3 are not subject to renegotiation, and such adjustments shall be deemed to include any cumulative effect of this and previously authorized changes.
- 1.2.5 Changes mutually agreed upon shall constitute a part of the work under this contract, and the provisions and conditions of the contract shall apply to the said changes.
- 1.2.6 In the event, the **PURCHASER** shall cause the **SUPPLIER** to expend labour or materials, or both, of any nature in order to provide the **PURCHASER** with information upon which to base a decision as to whether a change should be ordered, the **PURCHASER** shall reimburse the **SUPPLIER** for the total costs related to supplying such information. However in cases, where

such costs are involved, prior approval of **PURCHASER/PURCHASE COMMITTEE** shall be obtained.

1.2.7 Except with the express permission of the **PURCHASER**, the supply of goods shall not be delayed pending agreement of costs or schedules affected by minor changes.

1.3 Contract amendments

1.3.1 Subject to clause-1.2, no variation in or modification of the conditions and terms of the contract shall be made except by written amendment signed by the parties.

1.4 Sub-contracts & make of plant and machinery

1.4.1 The **SUPPLIER** shall not sub-contract all or any part of the contract without notifying the **PURCHASER** in writing, of the details of the sub-contractor and the item sub-contracted. Only approved sub-contractors of the **SUPPLIER** shall be employed.

1.4.2 The **SUPPLIER** guarantees that any and all sub-contractors of the **SUPPLIER**, for performance of any part of the work under the contract, will comply fully with the terms of the contract applicable to such part of the work under the contract.

1.4.3 The make of the main components to be supplied by the **SUPPLIER** shall be one of the makes specified in the **LIST OF APPROVED MAKES OF VENDORS** mentioned in Vol II (Technical), mutually agreed and specified in final technical offer. If the make of the component is not one of the vendors given in the approved list, the approval from the **PURCHASER & CONSULTANT** has to be obtained.

1.5 Country of origin

All major equipment shall be manufactured in India at the **SUPPLIER's** works.

1.6 Inspection and tests

1.6.1 The **SUPPLIER** shall submit the quality plan within six (6) weeks of entering into an agreement with the **PURCHASER**. The quality plan shall indicate the quality control procedure adopted by the **SUPPLIER** for inspection and in-process quality control procedures for the various items to be manufactured / procured / fabricated from their sub-vendors works. Based on the list, the **PURCHASER** or their inspecting agency shall send the **SUPPLIER** within two (2) weeks of receipt of the quality plan, the list of items of machinery and equipment requiring **PURCHASER's** inspection before dispatch.

1.6.2 The **PURCHASER / CONSULTANT / PURCHASER INSPECTION AGENCY**, shall have the right to inspect the work being carried out under this contract and to test the goods to confirm their conformity to the specification. The Special Conditions of Contract or the specification or both shall specify what inspections and tests the **PURCHASER** requires and where they are to be conducted. The **PURCHASER** shall notify the **SUPPLIER** in writing of the identity of **PURCHASER's/CONSULTANT's** technical staff retained for this purpose. Notwithstanding the inspection mentioned above, the **PURCHASER** has the right to reject the goods even after the supply, if they do not conform to the specification, and any defect found at the time of

installation and commissioning shall be rectified at **SUPPLIER's** cost and / or replaced if the defect cannot be rectified.

- 1.6.3 The inspections and tests may be conducted at the premises of the **SUPPLIER** or their sub-contractor(s), at point of delivery and at the final destination of goods. Where conducted at the premises of the **SUPPLIER** or their sub-contractor(s), all reasonable facilities and assistance, including access to drawings and production data, shall be furnished to the inspectors at no charge to the **PURCHASER**.
- 1.6.4 Should any inspected or tested goods fail to conform to the specification, the **PURCHASER** may reject them, and the **SUPPLIER** shall either replace the rejected goods or make all alterations necessary to meet the requirement of the specification, free of cost to the **PURCHASER**.
- 1.6.5 The **PURCHASER's** right to inspect, test and, where necessary, reject the goods after its arrival at the site of installation (the rejection shall be with proper justification and reasonably adequate time will be given to the **SUPPLIER** to remedy the default) shall in no way be limited or waived by reason of the goods' having already been inspected, tested and passed by the **PURCHASER** or their representatives prior to dispatch of the goods.
- 1.6.6 Nothing in the clause-1.6 shall in any way release the **SUPPLIER** from any warranty or other obligations under the contract.
- 1.6.7 Bidders to note that inspection report wherever applicable, MTC and Guarantee certificates will be required for all the supply items which will be cross checked with the OEMs and in case of fake supply of any item, action deemed fit will be taken by the Purchaser which will be binding on the Bidder.

1.7 Patent and copy rights

The **SUPPLIER** shall hold and have the **PURCHASER**, its Officers, Agents, Servants and Employees harmless from liability of any nature or kind including costs and expenses for over an account of any copy-right or un copy right, composition, secret process, patented or appliance un-patented invention, articles or manufactured or used in the performance of this contract including their use by the **PURCHASER** unless otherwise specifically stipulated in this contract. In the event of any claim or demand being made or action being brought against the **PURCHASER** for infringement or patent in respect of any machine, plant used or supplied by the **SUPPLIER** under this agreement or in respect of any method of using or working by the **PURCHASER** or such machine, Plant or thing, the **SUPPLIER** will indemnify the **PURCHASER** against such claims or demand and all cost and expenses arising from or incurred by reason of such claims or demands.

PROVIDED THAT the **PURCHASER** shall notify in writing the **SUPPLIER** immediately if the claim is made and that they shall be at liberty, if they so desire, with the assistance of the **PURCHASER**, if required, but at the **SUPPLIER's** own expenses to conduct all negotiations for the settlement of the same or any litigation that may arise there from and

PROVIDED THAT no such machines, plant or thing shall be used by the **PURCHASER** for any purpose or in any manner other than that for which they have been supplied by the **SUPPLIER** as specified in this tender.

1.8 Bank Guarantees

- 1.8.1 The formats for Bidders Bank Guarantees (BGs) will be as per standard formats. All nationalized banks and private banks viz ICICI, HDFC, Axis Bank, Standard & Chartered, Citi Bank are eligible for issuing of BGs.
- 1.8.2 The Bank guarantee in respect of guaranteed performance of the plant and machinery supplied by the SUPPLIER in the form of the PURCHASER, after mutual discussions between PURCHASER and SUPPLIER, before eight (8) months of scheduled commissioning of the plant. This guarantee shall be valid for two years from the date of commissioning. In the event of non-submission of performance guarantee, in the form of the PURCHASER after mutual discussions between the PURCHASER and SUPPLIER, the SUPPLIER shall deduct from their all bills, equivalent amount of bank guarantee till such time the bank guarantee is furnished, before drawing their bill
- 1.8.3 If the SUPPLIER shall abandon this contractor otherwise fail to supply and deliver the plant within the scheduled period or any extension thereof granted by the PURCHASER or if the work or any part thereof is taken out of the SUPPLIER hands, then and in any such case the SUPPLIER shall refund to the PURCHASER within thirty (30) days of demand such part of the advance payments hereunder made as the PURCHASER may deem fit to protect their interest.
- 1.8.4 The bank guarantee or guarantees required to be furnished by the SUPPLIER under the provisions thereof to secure the timely delivery or performance of the plant and machinery supplied by the SUPPLIER or for any other purpose under the provisions thereof shall be in the form of the PURCHASER and the SUPPLIER, which forms shall invariably include the provision that the decision of the PURCHASER as to whether there has been any loss or damage or default and or negligence on the part of the SUPPLIER will be final and binding of the guarantor, that the right of the PURCHASER shall not be affected or suspended by the reason of the fact that any dispute or disputes have been raised by the SUPPLIER with regard to their liability of that proceedings are pending before any tribunal / arbitrators or court with regard thereto or in connection therewith, that the guarantor shall pay to the PURCHASER the sum under the guarantee(s) without demur or first demand and without requiring the PURCHASER to invoke any legal remedy that may be available to them, that it shall not be open to the guarantor to know the reason of or to investigate or to go into the merit of the demand or to question or to challenge the demand or to know any facts affecting the demand or to required proof of the liability of the SUPPLIER before paying the amount demanded by the PURCHASER, under the guarantee(s).

The Bank Guarantee or guarantees required to be furnished by the SUPPLIER under the provisions thereof to secure the timely delivery or performance of the plant and machinery supplied by the SUPPLIER or for any other purpose under the provision hereof shall be for such period as may cover the period of complete supply and performance respectively, as the case may be as stipulated under the tender, if, however, the period of agreement is extended due to force majeure. The SUPPLIER shall have such guarantee extended upto the corresponding extended period, and failure of the SUPPLIER to do so will amount to a breach of the contract, and in no case the extension of the period of the contract shall be construed as waiver of right of the PURCHASER to enforce the guarantee.

1.9 Indemnity

- 1.9.1 The SUPPLIER and the PURCHASER shall indemnify and hold harmless each other from and against such claims and liabilities as provided in the Special Condition of Contract.

1.9.2 Notwithstanding anything in this contract to the contrary, it is agreed that neither the **SUPPLIER** nor the **PURCHASER** shall be held liable to the other party for loss of production, loss of profit, loss of use or any other indirect or consequential damage.

1.10 Insurance

1.10.1 All goods supplied under this contract shall be fully insured against loss or damage incidental to manufacture or acquisition in the manner specified in the Special conditions of contract.

1.10.2 Without limiting the **SUPPLIER's** liability (limited only to the contract price) as provided under this contract, the **SUPPLIER** shall procure or ensure that their **SUB-CONTRACTORS** also procure such additional insurance cover as specified in the Special Conditions of Contract.

1.10.3 All insurances to be provided by successful bidders, including transit insurance will be as per standard rules.

1.11 Transfer of title

1.11.1 The goods, shall immediately, in consideration of payment of the first installment of the contract price to the **SUPPLIER** by the **PURCHASER**, become and remain the property of the **PURCHASER**; provided always that the **SUPPLIER** shall have a particular possessory lien on the goods to the extent the value thereof exceeds the total value of the installment payments made by the **PURCHASER** to the **SUPPLIER**. Transfer of title of goods shall be ex-works.

1.12 Acceptance

1.12.1 Upon completion of the supply under the contract and erection and commissioning by the **PURCHASER's** contractor, a meeting shall be held for the purpose of accepting the goods (hereinafter called the final acceptance). Such meeting shall constitute the final acceptance of the goods and services under the contract, unless the **PURCHASER** during the meeting shows defects or shortcomings or both. In case of defects or shortcomings or both which in the **PURCHASER's** opinion are considered essential, another meeting shall be convened when the **SUPPLIER/CONTRACTOR** has given notice of completion of the corrective work carried out with regard hereto. Otherwise the **PURCHASER** may accept the goods if the defects or shortcomings or both are not considered serious, and the **SUPPLIER** has agreed to carry out the repairs in conformity with this contract.

1.13 Maintenance Warranty

1.13.1 For a period of two years from the date of commissioning of plant and machinery including the year in which the plant is commissioned (called the maintenance warranty period), the **SUPPLIER** shall remain liable to rectify / replace any machinery and equipment or part thereof, such as may be found to be defective or below the rated capacity under proper use and arising due to faulty design, material, workmanship. The **PURCHASER** shall give the **SUPPLIER** notice in writing setting out the particulars of the defects or failure and the **SUPPLIER** shall thereupon rectify and make good the defective or under rated equipment or replace the same free of cost to make it comply with the requirements of the Agreement. If the **SUPPLIER** fail to do so within reasonable time so as to reduce the production loss to the minimum as required by the **PURCHASER**, the **PURCHASER** may rectify and replace at the cost of the **SUPPLIER** the whole or any portion of the equipment, as the case may be, which is defective or under rated or

fail to fulfill the requirements of the Agreement and may recover the actual cost thereof from the SUPPLIER or adjust the same from any balance payment to be made to the SUPPLIER, or recover by raising debit note. Such rectification / replacement shall be carried out by the PURCHASER within short a time as possible and at a reasonable price under advice to the SUPPLIER.

In case of such rectification / replacement by the PURCHASER the SUPPLIER shall be liable to pay the PURCHASER the whole cost of such rectification / replacement done and the defective equipment on being replaced shall be taken away by the SUPPLIER at their own cost. The PURCHASER shall have the right to operate any and all equipments after the commissioning date of the plant except that this shall not be considered to permit operation of any equipment which may be materially damaged by such operation before any required rectification or alternation have been carried out.

- 1.13.2 If it becomes necessary for the SUPPLIER to replace or renew any defective part of the machinery under this clause the provisions of the first paragraph of this clause shall apply to the parts of the plant and machinery so replaced or renewed until the expiration of six months from the date of such replacement or renewal or until the end of the aforesaid maintenance period of two (2) years, whichever is later.
- 1.13.3 The rectification or new parts will be delivered F.O.R. PURCHASER's factory site. The SUPPLIER shall also bear the cost of rectification / replacement carried out on their behalf by the PURCHASER as mentioned above at the site. At the end of the maintenance period, SUPPLIER liability shall cease. In respect of plant and machinery not covered by the first paragraph of this clause, the PURCHASER shall be entitled to the benefit of any guarantee given to the SUPPLIER's by the original supplier or the manufacturer of each plant and machinery.
- 1.13.4 The responsibility of the SUPPLIER for rectification / replacement under this clause shall extend to the actual cost of rectification / replacement of the defective items of plant and machinery and shall not, in any way, be deemed to be limited to the amount of the performance guarantee.
- 1.13.5 The SUPPLIER shall provide one supervisor at their own expenses for first one month of the first crushing season in order to assist the PURCHASER in the working and maintenance of said machinery and equipment.

1.14 Payment

- 1.14.1 The PURCHASER shall pay the contract price in the following manner free of interest:
- 1.14.2 The payment terms will be as per *Appendix – II*.
- 1.14.3 All Payments shall be made in Indian rupee only. In case of imports, the terms of payments will be as per standard International practice
- 1.14.4 Subject to clause-1.2 of the General Conditions of Contract and as provided for in the price schedule, prices charged by the SUPPLIER for goods under the contract shall not vary from the prices agreed by the SUPPLIER and given in the price schedule. **This is the firm price contract for SUPPLY.**
- 1.14.5 Taxes and duties shall be reimbursable at actual, based on the production of documents by the SUPPLIER.

1.14.6 The **PURCHASER** shall not make any deductions against any claims he may have on the **SUPPLIER** as per the contract terms, unless the details of claim have been communicated to the **SUPPLIER** in advance.

1.15 Extension in the SUPPLIER's performance

1.15.1 Delivery of the goods shall be made by the **SUPPLIER** strictly in accordance with the delivery schedule, pursuant to the Special Conditions of Contract.

1.15.2 The **SUPPLIER** may claim extension of the time limits as set forth in the delivery schedule in case of:

- a. Changes ordered by the **PURCHASER** pursuant to clause-1.2;
- b. Delay in the receipt of any material, drawings or service which are to be provided by the **PURCHASER** (services provided by the **PURCHASER** shall be interpreted to include all approvals by the **PURCHASER** under the contract as well as access to the site);
- c. Force majeure pursuant to clause-1.21; and
- d. Delay in performance of work caused by instructions issued by the **PURCHASER**.

The **SUPPLIER** shall demonstrate to the **PURCHASER's** satisfaction that they have used their best endeavour to avoid or overcome such causes of delay, and the parties will mutually agree upon remedies to mitigate or overcome such causes of delay. The extension of time limit shall be mutually discussed and agreed.

1.15.3 Notwithstanding clause-1.15.2 above, the **SUPPLIER** shall not be entitled to an extension of time for completion, unless the **SUPPLIER**, at the time such circumstances arise, has immediately notified the **PURCHASER** in writing of any delay that it may claim as caused by circumstances pursuant to clause-1.15.2 above; and, upon request of the **PURCHASER**, the **SUPPLIER** shall substantiate that the delay is due to the circumstances referred to by the **SUPPLIER**.

1.16 Termination for default

1.16.1 The **PURCHASER** may, without prejudice to any other remedy for breach of contract, by written notice of default sent to the **SUPPLIER**, terminate the contract in whole or in part:

- a. If the **SUPPLIER** fails to deliver any or all of the goods within the time period(s) specified in the contract, or any extension thereof granted by the **PURCHASER**, pursuant to clause-1.15; or
- b. If the **SUPPLIER** fails to perform any other obligation(s) under the contract; and if the **SUPPLIER**, in either of the above circumstances, does not cure their failure within a period of ten (10) calendar days (or such reasonably longer period as the **PURCHASER** may authorize in writing) after receipt of a notice of default from the **PURCHASER** specifying the nature of the default(s).

1.16.2 In the event the **PURCHASER** terminates the contract in whole or in part, pursuant to clause-

1.16.1 above, the **PURCHASER** may procure, upon such terms and in such manner as it deems appropriate, goods similar to those undelivered, and the **SUPPLIER** shall be liable to the **PURCHASER** for any incidental excess costs for procurement of such similar goods. Notwithstanding the above, the **SUPPLIER** shall continue performance of the contract to the extent not terminated.

1.17 Termination for insolvency

1.17.1 The **PURCHASER** may at any time terminate the contract by giving written notice to the **SUPPLIER**, without compensation to the **SUPPLIER**, if the **SUPPLIER** becomes bankrupt or otherwise insolvent. Notwithstanding the above, such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the **PURCHASER**.

Provisions for termination for insolvency shall apply viz-a-viz to both the parties. In the event of termination for insolvency by the Supplier, provisions for termination for convenience by the Purchaser shall apply.

1.18 Termination for convenience

1.18.1 The **PURCHASER** may, by written notice to the **SUPPLIER**, terminate the contract, in whole or in part, at any time for their convenience. The notice of termination shall specify that termination is for the **PURCHASER**'s convenience, the extent to which performance of work under the contract is terminated, and the date upon which such termination becomes effective.

1.18.2 The goods that are complete and ready for dispatch within thirty (30) days after the **SUPPLIER**'s receipt of notice of termination shall be purchased by the **PURCHASER** at the contract prices and on the other contract terms. For the remaining goods, the **PURCHASER** may elect:

- (a) to have any portion thereof completed and delivered at the contract prices and on the contract terms; and/or
- (b) to cancel the remainder and pay to the **SUPPLIER** an agreed amount for partially completed goods and for materials and parts previously procured by the **SUPPLIER** for the purpose of the contract, together with a reasonable allowance for overhead and profit and a reasonable compensation, based on mutual discussions, for the financial commitments made by the **SUPPLIER** for fulfilling their obligations under this contract.

1.19 Resolution of disputes

1.19.1 The **PURCHASER** and the **SUPPLIER** shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the contract.

1.19.2 If, after thirty (30) days from the commencement of such informal negotiations, the **PURCHASER** and the **SUPPLIER** have been unable to resolve amicably a contract dispute, either party may require that the dispute be referred for resolution by arbitration by the mechanism described in the Special Conditions of Contract. The award shall be final and binding on the parties.

1.20 Jurisdiction for legal proceedings

1.20.1 The contract shall be governed by and interpreted in accordance with the Indian laws. No suit or any proceedings in regard to any matter arising in any respect under this contract shall be instituted in any court other than the court at Patna. No other court shall have jurisdiction to entertain any suit or proceedings even though part of the cause of action might arise within their jurisdiction.

1.21 Force majeure

1.21.1 In the event that the **SUPPLIER** or any of their subcontractors, or the **PURCHASER** delays performing any of their respective obligations under the contract, and such delay is caused by force majeure, by acts of God / Government in its sovereign capacity, including but not limited to war, civil insurrection, riots, strikes, fires, floods, epidemics, earthquakes, quarantine restrictions and freight embargoes, such delay may be excused as provided in clause-1.15, and the period of such delays, or a period mutually discussed and agreed, may be added to the time of performance of the obligation delayed.

1.21.2 If a force majeure situation arises, the **SUPPLIER** shall promptly notify the **PURCHASER** in writing of such condition and the cause thereof along with documentary evidence. Unless otherwise directed by the **PURCHASER** in writing, the **SUPPLIER** shall continue to perform their obligations under the contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the force majeure event.

1.21.3 In no event shall, a force majeure event excuse the obligations of a party, if those obligations are required to have been completely performed, prior to the occurrence of that force majeure event.

1.21.4 If performance of the Contractor's obligations or obligations of its vendors and subcontractors are delayed under the contract and such delay is caused by force Majeure conditions which prevents or impedes due performance of the contract despite due diligence by the contractor, the contractor shall get corresponding extension plus an additional period, if any, in time for completion without any claim of the Purchaser for damages for delayed performance.

If, Force Majeure affects the performance of the Purchaser for the reasons including land acquisition, environmental clearances or otherwise in such event the supplier shall be entitled to receive enhanced cost on a mutual agreed basis in addition to extension in time for corresponding period.

If Force Majeure prevails for more than three months, both the parties shall discuss and agree to further course of action including cost implications. Force Majeure shall not apply on payment obligations of the parties.

If, parties agrees to terminate the contract due to prolonged Force Majeure conditions affecting the performance of the purchaser. In such event of termination, provision for 'Termination for Convenience' shall apply.

1.22 Modification, Assignment and Subletting

1.22.1 The **PURCHASER's** contract may be amended, modified or rescinded only in writing signed by both the parties or their authorized agents or representatives by a change order issued by the **PURCHASER** and accepted by the **SUPPLIER** pursuant to the terms stated therein.

1.22.2 The **SUPPLIER** shall not assign, sublet in whole or in part, their obligation to perform under the contract, except with the **PURCHASER's** prior written consent. Such written permission if given shall not relieve the **SUPPLIER** from their obligations under the contract and they shall take full responsibility for all the work done by their **SUB-SUPPLIER**.

1.23 Contract language

1.23.1 The **SUPPLIER** and **PURCHASER** hereby represent that they have sufficient knowledge of the English language to understand fully the contract. The contract shall be in the English language, and all documentation related hereto will also be in the English language, except if otherwise specifically agreed in writing between the parties.

1.23.2 The **SUPPLIER** shall bear all costs of translation of documents to English and all risks of the accuracy of such translation.

1.24 Taxes and duties

1.24.1 **The SUPPLIER shall be responsible** for Central / State Sales Tax, Excise Duties, Special Excise Duties, Local Taxes and Other Taxes or duties at the destination point, on finished bought-out items supplied directly to site from sub-contractors works. The proof for the taxes duties and special excise duties, actually paid by the **SUPPLIER**, shall be submitted to the **PURCHASER** separately for own manufactured items and for bought-out items and claimed by the **SUPPLIER** from the **PURCHASER** as a reimbursement of the same in each Invoice / Bills to be submitted by **SUPPLIER**. The amount included in **SUPPLIER's** bill for payment of all such taxes, surcharges and duties will be computed on the basis of relevant statutory provision in force on the date of dispatch and shall be actual amount as paid by the **SUPPLIER**.

Price excludes all kinds of taxes, duties and levies including GST Central Sales Tax, Excise Duty (if levied) including Central Sales Tax, Works Contract Tax, BOWC cess etc. and fresh impositions and variations in rates of taxes, duties and levies, which shall be reimbursed by the Purchaser to the Supplier at actual on the basis of documentary proofs.

Entry tax, special entry tax and octroi duty, if applicable, will be settled and paid directly by the Purchaser.

GST, duties and levies shall also be remitted by the Purchaser to the Supplier.

If Purchaser wishes to avail benefit of concessional Central Sales Tax (as applicable) for interstate sales, Purchaser shall provide to the Supplier Central Sales Tax Declaration Forms C'/E-1 within 30 days of the end of each quarter.

In the event of Purchaser's inability to provide Central Sales Tax Declaration Form C'/E-1 and / or any other form/document as may be applicable and consequent to imposition of final demand upon the Supplier by the authorities, the Purchaser shall pay the differential sales tax, penalty and interest to the Supplier as per the demand notice so issued.

1.24.2 The **SUPPLIER** shall furnish to the **PURCHASER** with their bill excise duty gate passes in support of excise duty and special excise duty paid for the base price.

1.24.3 The **SUPPLIER** shall indicate in the contract price, (Refer price schedule), the estimated amount of GST, Central / State Sales Tax, Excise Duty, Special excise duties, Customs duty, local taxes and any other taxes or duties and octroy, if any payable by the **PURCHASER** for own manufactured items and bought-out items under the contract based on the rates prevailing at the time of submission of offer. The actual taxes and duties payable by the **PURCHASER** shall not exceed more than two (2) percent of the indicated values by the **SUPPLIER** in the price schedule, unless there is a change in rate of the taxes and duties imposed by State / Central Authorities. The **SUPPLIER** shall indicate clearly the rate at which the taxes and duties, octroi, etc. have been estimated by the **SUPPLIER** at the time of giving this offer.

1.24.4 The **PURCHASER** or their authorized representative shall be shown all original documents and accounting records in support of excise duties, customs duties on imported components charged and the original bill of the sub-contractors for satisfying that the single point sales tax, excise duty and special duties as aforesaid have actually been paid to the sub-contractors.

1.25 Headings

1.25.1 Headings, whether of clauses or of other parts of the contract, are for reference only and are not to be construed as part of the contract.

1.26 Waiver

1.26.1 Failure of either party to insist upon strict performance by the other party of any provision of the contract shall in no way be deemed or construed to affect in any way the right of that party to require such performance.

1.27 Foreign Exchange

Any foreign exchange required for import of the raw materials of equipment shall be arranged by the **SUPPLIER**, non-availability of foreign exchange shall not entitle the **SUPPLIER** any extension of time for commissioning of the plant.

2. SPECIAL CONDITIONS OF CONTRACT FOR SUPPLY

2.1 Definitions

In this document, the words and phrases listed shall have the meaning specified against each word or phrase. Words imparting singular shall include plural and vice versa and words imparting the masculine gender shall include feminine gender and words imparting persons shall include bodies corporate.

- a) "The **PURCHASER**" means M/s **HPCL Biofuels Ltd (HBL), Village Suguali, East Champaran, Bihar**
- b) "The **CONSULTANT**" means M/s. **MITCON Consultancy & Engineering Services Ltd.**, having their Registered Office at First Floor, Kubera Chambers, Shivajinagar, Pune – 411 005.
- c) "The **SUPPLIER**" means the individual or firm supplying the goods and providing the services under this contract.
- d) "The **GOODS/EQUIPMENT/PLANT**" means all of the equipment, machinery and/or other materials which the **SUPPLIER** is required to supply to the **PURCHASER** under the contract.
- e) "**The CONTRACT / AGREEMENT**" means the agreement entered into between the **PURCHASER**, and the **SUPPLIER**, as recorded in the contract signed by both the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.
- f) "**FOB**", "**C&F**" and "**CIF**" have the meanings assigned to them by the current edition of the international rules for the interpretation of the trade terms published by the International Chamber of Commerce.
- g) "The **SUB-SUPPLIER**" means any individual or firm or company, to whom part of the contract has been sublet by the **SUPPLIER** with the consent of the **PURCHASER**.
- h) "The **INSPECTOR**" means any person or agency nominated by the **PURCHASER**, from time to time, to inspect equipment stage-wise including final stage, before dispatch at **SUPPLIER's / SUB-SUPPLIER's** works as per the terms of the contract.
- i) "**SUB CONTRACT**" shall mean order placed by the **SUPPLIER** for any portion of the Contract or work, with the necessary consent of **PURCHASER**.
- j) "**CONTRACT PRICE**" means the `consideration' payable by the **PURCHASER** directly to the **SUPPLIER** as per the agreement and desire of **SUPPLIER** for the full and proper performance of contractual obligations under the contract between the **PURCHASER** and the **SUPPLIER**.
- k) "**DELIVERY**" shall mean the completion of delivery of all such goods within the delivery date specified in the contract, vide clause No.2.8.2 of the Special Conditions of Contract.
- l) "**SITE**" shall mean and include the land and other places on, into or through which the works and

the related facilities are to be erected or installed, at the **PURCHASER's** site at **Village Suguali, East Champaran, Bihar**

- m) "**DRAWINGS**" shall mean the technical specification which shall include engineering drawings, sketches showing plans, sections and elevations related to the contract together with modifications and/or revision thereto.
- n) "**SPECIFICATION**" shall mean and include schedules, detailed description, statements of technical data, performance characteristics, standards (Indian as well as International) as applicable and specified in the contract.
- o) "**ENGINEER/ENGINEER-IN-CHARGE**" shall mean the person so nominated by the **PURCHASER** for the time being or such other person as may be duly authorized and appointed in writing by the **PURCHASER** to act as site engineer for the purpose of the contract. In cases where no such engineer is so appointed, the word 'engineer' shall mean the **PURCHASER** or their duly authorized representatives.
- p) "**TESTS**" shall mean such process or processes to be carried out by the **SUPPLIER** as are prescribed in the contract or considered necessary by **CONSULTANT / PURCHASER** and **SUPPLIER** together after mutual discussions, in order to ascertain quality, workmanship, performance and efficiency of equipment or part thereof.
- q) "**APPROVAL**" shall mean and include the written consent, either manuscript, type written or printed statement, under signature or seal, as the case may be, of the **PURCHASER/CONSULTANT** or their authorized representative on documents, drawings or other particulars in relation to the contract.
- r) "**DATE OF CONTRACT**" shall mean the date on which the parties have signed the Contract Agreement.
- s) "**THE ZERO DATE OF THE CONTRACT**" shall be the date on which the Letter of Intent (LOI) is given or Contract Agreement is signed.
- t) "**MONTH**" shall mean the calendar month.
- u) "**DAY AND DAYS**" shall mean the calendar day or days of twenty four (24) hours each.
- v) "**WEEK**" shall mean a continuous period of seven (7) days.
- w) When the words 'Approved', 'Subject to Approval', 'Satisfactory', 'Required', 'As Directed', 'Where Directed', 'Determined By', 'Accepted', 'Permitted', or words or phrases of like importance are used, the approval, judgment, direction etc., are understood to be a function of **PURCHASER / CONSULTANT**.
- x) "**SCOPE OF WORK**" shall mean all the work to be performed by the **SUPPLIER** under this contract.
- y) "**OPERATING MONTHS**" shall mean the period of actual operation of the equipment without taking into account the intervening off-season shutdown or shutdown due to major plant breakdown.

- z) “**COMMISSIONING**” shall mean the first operation of the equipment (after all initial adjustments, trials, cleaning and reassembly required at site if any, have been completed) and the equipment is ready for commercial use.
- aa) “**SATISFACTORY COMMISSIONING**”, means the continuous operation of the equipment to the full capacity and establishment of its strict performance of the contractual requirement.

2.2 Scope of the contract

- 2.2.1 The **SUPPLIER's** scope of work comprises of the detailed design, procurement, fabrication / manufacture, inspection and testing at the works and supply of plant and machinery on F.O.R. site basis, as defined in the technical specification, with all their accessories, fittings, supports and all the auxiliary equipment and material as detailed in the specification.
- 2.2.2 Wherever it is stated in this contract that such and such a supply is to be effected or such and such a work is to be carried out, or provided, it shall be understood that the same shall be effected/carried out by the **SUPPLIER** within the contract price, unless a different intention is specifically and expressly stated herein or otherwise explicit from the context.
- 2.2.3 Completeness of the equipment, within the battery limits, shall be the responsibility of the **SUPPLIER**. Any equipment, fittings and accessories which may not be specifically mentioned in the specification or drawings, but which are usual or necessary for the satisfactory functioning of equipment (successful operation and functioning of the equipment being **SUPPLIER's** responsibility) shall be provided, by the **SUPPLIER** without any extra cost to the **PURCHASER**.
- 2.2.4 Furnishing to the **PURCHASER**, foundation drawings and loading details relating to plant and machinery within the **SUPPLIER's** scope progressively at an agreed time schedule.
- 2.2.5 The **SUPPLIER** shall ensure that the work shall be of the first class quality and shall be performed:
 - a. with due diligence and efficiency.
 - b. in accordance with the provisions of the Contract and the time schedule indicated in this Contract.
- 2.2.6 The **SUPPLIER** shall at all times ensure that the work is carried out by fully qualified and experienced personnel to warrant the performance of the work in accordance with this agreement.
- 2.2.7 The **SUPPLIER's obligations** towards this contract include participation in the performance testing, trial operation and reliability run of the plant and equipment.
- 2.2.8 The training of the **PURCHASER's** personnel at the **SUPPLIER's** works and / or at the site.
- 2.2.9 The **SUPPLIER** is responsible for packing (sea worthy wherever necessary) protecting and marking as per instructions to be given by the **PURCHASER**.
- 2.2.10 Providing all the necessary drawings / documents / manuals. Instructions for all the equipment /

components / materials required for the proper understanding, erection and commissioning of the equipment by the **PURCHASER's** erection and commissioning contractor.

2.2.11 Bidders to note that inspection report wherever applicable, MTC and Guarantee certificates will be required for all the supply items which will be cross checked with the OEMs and in case of fake supply of any item, action deemed fit will be taken by the Purchaser which will be binding on the Bidder.

2.3 Limit of contract

Equipment supplied shall be complete in every respect with all mounting, fittings, fixtures and standard accessories, tools etc., normally provided with such equipment and / or needed for maintenance, completion of installation and commissioning and safe operation of the equipment as required and within the battery limits, though they may not have been specifically detailed in the respective specification. All similar standard component / part of similar standard equipment provided shall be interchangeable with one another.

Any additional equipment or material which are not specifically mentioned but are required to complete the equipment and system offered, in every respect in accordance with the technical specification and required for safe and reliable operation and guaranteed performance, shall also be deemed as included in the scope of work of this contract. The **SUPPLIER** shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures, accessories, etc., which are needed for the safe operation of the equipment as required by applicable codes, though they may not have been explicitly spelt out in the contract. However if new equipment are to be added due to change of government rules, then such new equipment will come under additional scope of work.

2.4 Codes and Standards

The goods supplied under this contract shall conform to the codes and standards mentioned in the technical specification, and, when no applicable standard is mentioned, to the authoritative codes and standards and such standards shall be the latest issued by the concerned institution. In the event that the language of such codes and standards happens to be anything other than English, the **SUPPLIER** shall furnish the English translation of all such codes and standards proposed to be used in the contract. Such English translations shall be provided to the **PURCHASER / CONSULTANT** within the first four (4) weeks from the date of the contract and the **SUPPLIER** shall undertake the full responsibility for the accuracy of such translations.

2.5 Materials and workmanship

The materials and workmanship shall meet the requirement of relevant standards and good engineering practices. In any case, the material shall be the best grade obtainable and the most suitable and proven for the purposes intended in accordance with the modern engineering practices. **All materials shall be new.** Substitutions for specified materials or variations from designed methods of fabrication will be permitted only if approved in writing by the **PURCHASER/CONSULTANT**. Such approvals may be granted only if a compelling reason exists for making a substitution.

Before any defect in material or workmanship is repaired, the **SUPPLIER** shall outline the procedure proposed for rectification of the defect and obtain approval in writing, of the **PURCHASER/CONSULTANT**. Such repairs shall be done free of cost to the **PURCHASER**, if the defects are established to have occurred during the warranty period.

2.6 Statutory approval for works

- 2.6.1 The application for submission to inspector, or any other authority required as per statutory rules and regulations of State / Central governments along with copies of required certificates complete in all respects shall be prepared by the **SUPPLIER**. The primary responsibilities for statutory approvals and liaison with government authorities for approvals, during the manufacturing and till such time the equipment and material are shipped from the **SUPPLIER's / SUB-SUPPLIER's** premises, shall be with the **SUPPLIER**.
- 2.6.2 Any change / addition required to be made to meet the requirement of the statutory authorities, if such change / addition of the statutory requirement come into force before the date of signing of the contract, shall be carried out by the **SUPPLIER** free of charge. The changes / additions required and additional charges thereon, consequent to the statutory regulations coming into force after the date of signing of the contract, shall be paid by the **PURCHASER** after mutual agreement. The inspection and acceptance of the work by statutory authorities shall, however, not absolve the **SUPPLIER** from any of their responsibilities under the contract.

2.7 Testing and inspection

- 2.7.1 The equipment will be inspected and where practicable, submitted to such tests at the works as deemed necessary by the **SUPPLIER** before dispatch.
- 2.7.2 The **SUPPLIER** shall give the **PURCHASER** a minimum of seven (7) days' written notice whenever any equipment / component / material is ready for testing. The **PURCHASER** shall, unless they waive witnessing of the tests, attend such tests on the notified scheduled date of testing. In case the Inspection Agency feels that inspection will be delayed before despatch, they will accordingly send a clearance to the **SUPPLIER** with an instruction to despatch the material. Such materials will be inspected at site. The **SUPPLIER** shall show necessary test certificates and documents for the verification of the same as per the specification of contract.
- 2.7.3 Where the **PURCHASER's** representative is present to witness the tests, the test certificate shall be signed by him on successful completion of tests at **SUPPLIER's / SUB-SUPPLIER's** works. In case the **PURCHASER** is not satisfied with the tests, they shall within seven (7) days of witnessing the tests, inform the **SUPPLIER**, in writing, of any objection they have with regard to any equipment and workmanship with reference to the contractual provisions. The **SUPPLIER** shall give due consideration to such objections and shall either make the modification that may be necessary to meet the said objections or shall confirm in writing to the **PURCHASER** giving necessary reasons, that no modification is necessary to comply with the contract. Notwithstanding the test certificates, any defect found at the time of installation or after installation and commissioning shall be rectified at the **SUPPLIER's** cost.
- 2.7.4 Bidders to note that inspection report wherever applicable, MTC and Guarantee certificates will be required for all the supply items which will be cross checked with the OEMs and in case of fake supply of any item, action deemed fit will be taken by the Purchaser which will be binding on the Bidder.

2.8 Work schedule

- 2.8.1 Timely delivery of the plant and equipment shall be the essence of the contract. The **SUPPLIER** shall so organize their resources and perform this work as to complete it on or before the date given in the following clause.
- 2.8.2 The following shall be the schedule for the completion of various milestone activities for this package. The **SUPPLIER**'s time schedule shall strictly conform to this schedule.

Milestone activity	Completion date
1. Engineering Activities 2. Completion of Supply 3. Commencement of erection 4. Completion of commissioning	To suit commissioning within 12-months for Incineration boiler & Aux. with BoP from zero date of the contract i.e. date of issue of LOI/PO, whichever is earlier

- 2.8.3 If the situation warrants, consequent to a delay in the manufacturing process, the **SUPPLIER** shall arrange to air lift the equipment to meet with the delivery commitment. All expenditure towards such air lifting, including tax implication if any, shall be to the **SUPPLIER**'s account, in case the delay in supply is directly attributable to the **SUPPLIER**.
- 2.8.4 The **SUPPLIER** within fifteen (15) days of the signing of agreement shall furnish dispatch wise break-up prices. The **SUPPLIER** within fifteen (15) days of signing of contract agreement shall furnish a time schedule of deliveries relating to major equipments and erection work, which shall be adhered to, for enabling completion of erection and commissioning. The delivery schedule shall be finalized with the approval of **PURCHASER/CONSULTANTS**.
- 2.8.5 Time schedule network / bar chart.
- 2.8.5.1 The **SUPPLIER** shall submit to **PURCHASER / CONSULTANT**, their time schedule regarding the documentation, manufacture and supply of the equipment and materials as well as information on their sub-contracts to be placed with third parties, including the dates on which the **SUPPLIER** intends to issue such sub-contracts.
- 2.8.5.2 The time schedule will be in the form of a network or a bar chart clearly indicating all main or key events regarding documentation, supply of raw materials, manufacturing, testing and delivery.
- 2.8.6 Progress trend chart / monthly report.
- 2.8.6.1 **SUPPLIER** shall report monthly on the progress of the execution of contract and achievement of targets set out in time bar chart.
- 2.8.6.2 The progress will be expressed in percentages as shown in the form of progress trend chart.
- 2.8.6.3 The monthly reporting will be the updating of the progress trend chart.

2.8.6.4 The progress reports shall be submitted once in every month for the first three months and subsequently once in every fortnight till the completion of the contract.

2.8.6.5 The monthly progress report shall be in the form to be given by the **PURCHASER** showing the progress in connection with the all the items like the progress of the submission of drawings, placing of order for bought outs, delivery of plant and machinery and compliance of contractual obligations, before the Tenth day of month, with a copy thereof endorsed to CONSULTANT

2.8.6.6 Photographs wherever necessary shall be submitted. The progress report shall further compare actual versus projected completion dates as well as describe current and anticipated problems and delaying factors, if any, and corrective action taken or proposed to be taken without in any way relieving or affecting the **SUPPLIER's** responsibility to deliver the equipment within the stipulated delivery date(s) / period(s).

2.9 Invoices and payments

Upon delivery of the goods, the supplier shall notify the purchaser and the insurance company by E-mail the full details of the shipment including contract number, transport carrier receipt number and date, description of goods, quantity, name of the consignee etc. The **SUPPLIER** shall mail the following documents to the purchaser with a copy to the insurance company:

- (i) Three (3) copies of the **SUPPLIER's** invoice showing description of goods, quantity, unit price and total amount.
- (ii) Transport receipt / acknowledgement of receipt of goods from the consignee(s);
- (iii) Certificate of origin for imported direct despatchable finished goods.
- (iv) Packing list as required as per clause-2.10.

The above documents shall be received by the **PURCHASER** before receipt of the goods (except where the goods have been delivered directly to the consignee with all documents) and, if not received, the **SUPPLIER** will be responsible for any consequent expenses/losses.

- (v) The **SUPPLIER** shall send all duplicate for Transporter copies of cenvat invoices along with original for Buyer copies directly to the **PURCHASER** to their registered office address to avoid loss of such documents in transit. The **SUPPLIER** shall send only Xerox of the duplicate for Transporter copies of the cenvat invoices through the vehicles carrying the consignments.
- (vi) If the **SUPPLIER** fails to send such documents directly and in the event of such documents getting lost in transit, the **SUPPLIER** shall be fully responsible to compensate the **PURCHASER** from loss of cenvat credit and the **PURCHASER** shall be at liberty to deduct from the dues of the **SUPPLIER**, amounts equivalent to such losses towards compensation.
- (vii) All Payments will be released by the **PURCHASER** only after 30 days from the date of certification of the **SUPPLIER's** bill by **EIC & Consultant**

2.10 Packing

2.10.1 The **SUPPLIER** shall provide such packing of goods as is required to prevent their damage or

deterioration during transit to their final destination as indicated in the contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the goods' final destination and the absence of heavy handling facilities at all points in transit.

2.10.2 The packing, marking and documentation within and outside the packages shall comply strictly with such special requirement as shall be provided for in the contract and in subsequent instructions by the **PURCHASER**.

2.10.3 **SUPPLIER** shall furnish one (1) original and five (5) copies of a packing list for each shipment. This packing list shall be prepared on **SUPPLIER's** standard formats. Packing list must include the following:

- Date
- Supplier's reference number
- Full name and address of the supplier or manufacturer
- Full name of consignee (**PURCHASER**)
- Import license number, where applicable
- Itemized list of contents of each package, case, crate etc. identified by the contract number, item number and equipment or tag number, where applicable.
- Quantity of each item actually being shipped
- Copy of all marking as shown in each package or piece
- Number and type of package and/or pieces in each shipment. Each package and / or piece shall be numbered consecutively to indicate individual and total packages: i.e., 1 of 5, 2 of 5 etc. (succeeding shipments against same order number will carry progressive package numbers: i.e., 3 of 5, 4 of 5, 5 of 5 etc.)
- Shipment number - packing list must indicate if shipment is partial or final shipment of order. Each partial shipment will be consecutively indicated as "partial shipment" No.1 or 2 or 3 etc. as applicable. Final shipment shall be indicated as "final shipment". A shipment of an entire order in one shipment shall be indicated as "complete shipment".
- Net and gross weight of each package and / or piece, and the total weight of the shipment.
- Dimensions and volume of each package and / or piece and the total volume of the shipment.

2.11 Documents, drawings & instruction manuals

2.11.1 All drawings, specification, design calculations and bill of material prepared by the **SUPPLIER**, shall comply with the following instructions unless otherwise directed in writing by **PURCHASER/CONSULTANT**. The term "drawing" as used in this specification shall mean and include sketches, design drawings, design calculations, specification and bill of materials unless otherwise defined. Design calculations to be submitted by the **SUPPLIER** shall include the working stress, the safety factor used, codes and standards used, etc., excepting those proprietary in nature. Drawings and data, furnished by the **SUPPLIER** for construction use, shall be certified as such and shall bear the signature of one of the authorized persons, whose names shall previously be given in writing to the **PURCHASER/CONSULTANT**.

- 2.11.2 The **PURCHASER/CONSULTANT** will after mutual discussions with the **SUPPLIER**, select the drawings / documents for approval by **PURCHASER/ CONSULTANT** or for their information.
- 2.11.3 It is understood that the approval or release by **PURCHASER/CONSULTANT** does not include the checking of drawings and other errors, but only review of basic concepts and general principles involved. Approval does not relieve the **SUPPLIER** of responsibility for correctness of design, details, dimensions and guarantee obligations.
- 2.11.4 All design drawings shall be oriented to match the plant arrangement drawings and shall have a key plan identifying the plant area to which they apply. All layout drawings shall be made with the north arrow pointing to the top of the sheet or to the left. There shall be sufficient reference notes on the drawings to permit identification of all the drawings which are required for a proper understanding.
- 2.11.5 All drawings shall be dimensioned in the metric system. Where drawings are usually made in the British (or other) system, they shall also have metric system dimensions in parentheses or below dimension line. Titles and written notations shall be in English.
- 2.11.6 The scale of the drawing shall be shown clearly in the title block of the drawing. Wherever possible scales of drawings shall correspond to the recommendation of the Bureau of Indian Standards.
- 2.11.7 All reproducible must be made from original drawings.
- 2.11.8 All revised drawings shall clearly indicate the number, date and subject of each revision.
- 2.11.9 The **SUPPLIER** shall submit to **PURCHASER/CONSULTANT**, in the first contract meeting, a list of all drawings and data, by title, which the **SUPPLIER** expects to supply against the contract. On receipt of the list **PURCHASER/ CONSULTANT** and **SUPPLIER** shall jointly finalize a schedule for the submission of drawings.

The **SUPPLIER** shall maintain the pace of work as required by the schedule. Drawing list shall be kept upto-date, incorporating all new additions, cancellations and changes and will be reissued periodically with the periodical progress reports.

- 2.11.10 The **SUPPLIER** will be required to furnish all the necessary drawings, data, etc. of the plant/equipment with appropriate "status" stamp in adequate number of copies as indicated below.

S.No	Status of the drawing/ document etc.	No. of copies for Purchaser	No. of copies for Consultant
1.	Reference/information	4 prints	2 prints
2.	For approval	2 prints	3 prints
3.	Final & certified duly signed	6 Prints & 1 CD	1 Print & 1 CD

4	Operation and maintenance manual	4 copies	1 copy
5	Performance and acceptance test procedure	2 copies	1 copy
6	All other documents including erection drawings	2 copies	1 copy

2.11.11 Within a period of ten (10) days after the receipt of those drawings/documents, the **PURCHASER / CONSULTANT** shall signify their approval or otherwise. Corrected drawings / documents shall be submitted to the **PURCHASER / CONSULTANT** within ten days after the receipt of the commented drawings/documents by the **SUPPLIER**. The **SUPPLIER** shall submit copies of all drawings which are required to be approved by the **PURCHASER / CONSULTANT**. The drawings which are approved by the **PURCHASER / CONSULTANT** shall not be deviated from, without the further approval of the **PURCHASER / CONSULTANT**.

2.11.12 All drawings submitted for approval shall contain the name of the **PURCHASER**, name of the **CONSULTANT**, project title, drawing title, scale, **SUPPLIER**'s drawing number, date of drawing etc. in the lower right hand corner.

2.11.13 The **SUPPLIER** shall have the right to improve with the **PURCHASER**'s approval, the design of equipment without affecting the basic requirement of the **PURCHASER**, and without affecting the agreed contract price.

2.12 Liquidated damages for delay in delivery

The **SUPPLIER** shall endeavor to complete their scope of work within the time specified in the contract. It may be noted that "time is the essence of this contract", subject to clauses-1.15 and 1.21 of the General Conditions of Contract. If the **SUPPLIER** fails to supply any or all of the goods within contract stipulated time in the contract to suit commissioning within 12-months from the zero date of the contract, the **PURCHASER** shall, without prejudice to their other remedies under the contract, deduct from the contract price, as liquidated damages, a sum equivalent to 0.5% of the total contract price for each week of delay until actual performance, up to a maximum deduction of 5% of the total contract price, the total contract price being inclusive of subsequent modifications and price escalation, if contractual. Once the maximum is reached, the **PURCHASER** may consider termination of the contract.

2.13 Indemnity

2.13.1 The **SUPPLIER** shall indemnify and hold harmless the **PURCHASER / CONSULTANT** from all claims, losses, demands, causes of action or suits arising out of the equipment and material furnished by them. The **SUPPLIER** shall also indemnify the **PURCHASER** against all third party claims, any infringement of trade mark or patent or industrial design rights arising from use of the goods or any part thereof. Indemnity Clause shall apply to both the parties equally.

2.13.2 **SUPPLIER** shall conform to the provisions of Indian Boiler Regulations (as applicable), Indian Factories Act, Indian Electricity Rules etc. relating to the work and to the regulations and by laws of any authority, if required.

2.14 Insurance

2.14.1 The **SUPPLIER** is responsible for comprehensive risk, insurance including transit charges of all machinery and equipments, other consumables, directly dispatched to the **PURCHASER** Sugars plant site from the **SUPPLIER** / Sub-contractors or sub-**SUPPLIER** respective place of manufacture and despatch and the insurance policies in respect thereof shall be arranged by the **SUPPLIER** at such premium rates with such insurance companies as may be approved by the **PURCHASER** and kept in full force and effect until commissioning of the said plant.

2.14.2 Any consignment received at the place of destination in damaged conditions or is lost in transit, the representative of the **SUPPLIER** / **SUPPLIER'S** erection contractor will take an open delivery from the carriers and will give suitable remarks in the delivery book maintained by the Station Master or other carriers about the loss or breakage in transit. The representatives of the **SUPPLIER** shall lodge claims with the Railway or other carriers on behalf of the **PURCHASER** in time with a copy to the **PURCHASER** for information. All realization of claims from the carrier / railway and insurance company, whether in the name of the **SUPPLIER** shall be to the account of the **SUPPLIER**. The **SUPPLIER** shall supply the replacement of machinery and equipments, goods free of cost delivered at the site to the **PURCHASER** within the time as far as possible so as to adhere to the date of commissioning.

2.14.3 All goods supplied under this contract shall be fully insured by the **PURCHASER** on all risks basis against loss/damage during transit from the place of manufacture of the **SUPPLIER** and from the places of manufacture of their Sub-**SUPPLIER** to the site of installation.

2.14.4 If there is any loss or damage to goods, within 15 days of such occurrence the **SUPPLIER** will take action to make good the loss so that it will not affect the overall time schedule of the project.

2.15 Performance guarantee

2.15.1 The **SUPPLIER** shall guarantee that the performance of the equipment supplied under the contract shall be strictly in conformity with the requirement given in the specification and shall perform the duties specified under the contract. The performance trials will be conducted in the presence of authorized representatives of:

- a. Purchaser
- b. Supplier
- c. Consultant
- d. Representative of Erector

2.15.2 If the performance of the equipment fails to prove the guarantee set forth in the specification, **SUPPLIER** shall investigate the causes and provide, free of cost to **PURCHASER**, materials, and equipment within one (1) month or such reasonable period, to be mutually discussed and agreed, to prove the guarantees.

- 2.15.3 If the **SUPPLIER** fails to prove the guarantee within the reasonable period, as mutually agreed upon, **PURCHASER** shall have the option to take over the equipment and rectify, if possible, the equipment to fulfill the guarantees and or to make necessary additions to make up the deficiency at **SUPPLIER's** risk and cost. All expenditure incurred by the **PURCHASER** in this regard shall be to **SUPPLIER's** account.
- 2.15.4 The manufacturers' guarantees for all bought out items/equipment/instruments etc., shall be made available to the **PURCHASER** and shall be valid for the entire maintenance warranty period. If such guarantees are not issued by the manufacturer, the **SUPPLIER** shall guarantee the bought out items for the entire maintenance warranty period along with their guarantee for the plant as a whole.
- 2.15.5 In the event of failure of any particular part of any equipment more than three times during the maintenance warranty period, it shall not be repaired but the complete part shall be replaced by the **SUPPLIER** and the warranty for this particular part shall be extended by one year from the date of last replacement or the maintenance period of two crushing season, whichever is later.
- 2.15.6 In case it is found that the above mentioned failure is due to some connected part of the equipment, that part shall also be rectified or replaced by the **SUPPLIER** to avoid such failure in the future. The warranty for such replaced parts shall be extended by one year, for parts replaced within six (6) months of commissioning of the equipment, and six months for parts replaced after six months of commissioning of the equipment, from the date of last replacement. or the maintenance period of two crushing season, whichever is later.
- 2.15.7 For electrical motors, during the warranty period, in case some important part of the motor like stators, winding, shaft, squirrel cage rotor etc., become defective, the warranty shall cover its replacement, and no repairs shall be allowed.

2.16 Spare parts, lubricants

- 2.16.1 All the spare parts for the equipment under the contract will strictly conform to the specification and other relevant documents and will be identical to the corresponding main equipment / components supplied under the contract and shall be fully interchangeable.
- 2.16.2 Commissioning spares are not envisaged separately. However, any and all requirement of commissioning spares until commissioning of plant shall be **SUPPLIER's** responsibility.
- 2.16.3 The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.
- 2.16.4 The **SUPPLIER** will provide the **PURCHASER** with the addresses and particulars of all their **SUB-SUPPLIER** while placing the order on vendors for items / components / equipment covered under the contract and will further ensure with their vendors that the **PURCHASER**, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
- 2.16.5 Apart from the requirement of this clause, the **SUPPLIER** shall maintain all critical spares, and shall undertake to supply them as and when required during the life time of the unit, at the prevailing prices and with in a reasonable time required for supply, such that the **PURCHASER** does not face any hardship due to the machine break down and the consequent loss of production.

2.16.6 Details of all the spare parts are required to be provided in the item master format (format will be shared by Purchaser to L1 bidder after award of PO) which will include all the technical details regarding the spare parts along with indicative price, approved suppliers with their details for ease in procurement after installation

2.16.7 In the event of termination of production of the spare parts by the **SUPPLIER** or their **SUB-SUPPLIER**:

2.16.7.1 The **SUPPLIER** shall give advance notification to the **PURCHASER** of the impending termination of production, in sufficient time to permit the **PURCHASER** to procure their requirement.

2.16.7.2 Following such termination, the **SUPPLIER** shall furnish to the **PURCHASER**, at no extra cost to the **PURCHASER**, blue prints, drawings and specification of the spare parts, if and when required.

2.17 Licenses and permits

The **SUPPLIER** shall procure necessary permits, certificates and licenses such as from the Chief Inspector of Boilers (as applicable), Electrical Inspectorate, Inspector of Factories, and such statutory bodies required by virtue of all applicable law, regulations, ordinances and other rules in effect at the place where any of the work is to be performed and the **SUPPLIER** shall further agree to hold the **PURCHASER** harmless from liability or penalty which may be imposed by reason of asserted or established violation of such laws, regulations, ordinances or other rules.

2.18 Arbitration

If at any time there should be any question, dispute, difference between the parties in respect of any matter arising out of or in relation to the contract, either party may give to the other party notice in writing of the existence of such question, dispute or difference, and the same shall be referred to the arbitration of panel of Engineers appointed by each party as per prevailing arbitration act.

The award of the Arbitrator shall be final and binding of the parties and be accepted by them. This reference to the Arbitrator shall be deemed to be reference, under the provisions of the Arbitration Act, 1996 and the rules made there under and any statutory modifications or recent amendment thereof that may be made from time to time and actually in force at the time of the reference. The cost of arbitration shall be borne by the parties as may be decided upon by the Arbitrator.

2.19 Instructions, directions and correspondence

2.19.1 The materials and equipment described in this contract are to be supplied according to the standards, data sheets, tables, specification enclosed with the contract itself and according to all conditions specified in the contract.

2.19.1.1 All instructions and orders to **SUPPLIER** shall, excepting what is herein provided, be given by **PURCHASER** and/or **CONSULTANT**, in writing.

2.19.1.2 All the work shall be carried out under the direction of and to the satisfaction of **PURCHASER/CONSULTANT**.

2.19.1.3 All communications, from **SUPPLIER**, including technical-commercial clarifications and/or

comments shall be addressed to **PURCHASER** with a copy to **CONSULTANT** and shall always bear reference to the contract.

2.19.1.4 Suitable **PURCHASER** identification numbers shall be shown on all invoices, communications, packing lists, containers and bills of lading, etc.

2.19.1.5 Correspondence on technical and commercial matters shall be dealt in separate letters and each copy of the letter shall be complete with all annexures.

2.20 Excess materials

2.20.1 This contract is for the supply of the equipment as specified, along with all their accessories and auxiliaries and the **SUPPLIER** shall supply all the equipment and material required for this purpose. Any excess material over and above this requirement supplied by the **SUPPLIER** shall be taken back by the **SUPPLIER** after the satisfactory commissioning of the plant.

2.20.2 The **SUPPLIER** has to take all care for the safety of such excess materials and the **PURCHASER** is not responsible for any loss or damage to such materials

2.21 Contract coordination procedure

2.21.1 The **SUPPLIER** shall identify one of their senior executives as the contract coordinator. The contract coordinator shall liaison closely with **PURCHASER's** executives and **CONSULTANTS** for the effective completion of the project within the stipulated time schedule.

2.21.2 The **SUPPLIER** shall prepare a contract coordination procedure in consultation with the **PURCHASER / CONSULTANT** for the smooth execution of the work. It shall cover, but not limited to, the following:

- a. Contract coordinators
- b. Progress review meeting / Engg. review meeting
- c. Progress reporting
- d. Billing procedure
- e. Inspection co-ordination procedure
- f. Shipping procedure
- g. Expediting procedure

2.22 Performance tests and Guarantee

The **SUPPLIER** shall guarantee the following:

- a. That all the machinery and equipment shall work as specified in Volume II forming part of the tender.
- b. That all the machinery and equipments will be brand new of latest design and first-class material and workmanship. Any part found defective, within two crushing season from the date of commissioning of the plant, shall be replaced or satisfactorily rectified by the **SUPPLIER** free of charge, should such defect be due to either faulty design / workmanship or use of defective material.

- c. Defects liability Period: 12 months from the date of completion of the entire job. (To be read together with General terms & Conditions)
- d. As per GTC, Original PBG for defect liability period (If Bidder chose not to deduct 10% retention) to be submitted at Purchase dept, Patna and copy at site.

The performance tests on the Incineration boiler & Aux with BoP shall be conducted within six (6) weeks from the date of commissioning. Upon successful completion of performance tests required by the **PURCHASER** and availability of the documentation including the layout and arrangement as built drawings and maintenance manuals, as well as fulfillment of all other obligations by the **SUPPLIER**, taking over certificate as a proof of final acceptance of the equipment/ system under scope of supply will be issued by the **PURCHASER**. The taking over certificate shall not be unduly delayed without assigning any acceptable reason.

If the performance test could not be conducted within the five (5) months' period, owing to an intervening off-season, the test shall be conducted immediately after the starting and stabilization of the next cane crushing season, applying the internationally accepted ageing factors, failing which the conducting of performance test and any extension of performance bank guarantee will be mutually discussed.

2.23 Penalty for shortfall in performance (detailed in Appendix IV)

2.23.1 The **SUPPLIER's** guaranteed performance included as part of this contract shall be binding on them.

2.23.2 The terms of guarantee fall under two categories:

2.23.2.1 Items for which penalties will be leviable for shortfall in performance.

2.23.2.2 Items for which shortfall in performance is not acceptable beyond a permissible tolerance.

2.23.3 The **Appendix IV** gives the penalties leviable for the shortfall in performance of the plant and equipment supplied.

2.23.4 If the total value of penalties for shortfall in performance exceed ten (10) percent of total contract price, and the **SUPPLIER** has expressed his inability to rectify the defect and bring the equipment performance to the guaranteed level, then the **PURCHASER** retains the option to reject the equipment, and in case of such option the **SUPPLIER** shall, jointly and severally, replace the equipment with the one, which shall meet the guaranteed figures. The replacement shall be done within a reasonable period mutually agreed and at no extra cost to the **PURCHASER**.

2.23.5 For those items for which shortfall in performance is not acceptable beyond a permissible tolerance, vide clause 2.23.4 above, the **SUPPLIER** jointly and severally, shall carry out modifications to obtain the guaranteed performance within the stipulated tolerance. It may be noted that as these are primary parameters, they must be corrected even before the trial run is started, and further, these parameters must remain stable throughout the period of trial run.

2.23.6 If finally, in spite of all practical efforts on the part of the **SUPPLIER**, the stipulated guarantees on these parameters are not established, the **PURCHASER** retains the option to reject the equipment. In case the option to reject is exercised by the **PURCHASER**, the **SUPPLIER** shall jointly and severally be responsible for the replacement of the rejected equipment within a reasonable period of time as will be indicated by the **PURCHASER** and achieve the performance as guaranteed.

2.23.7 In the event of rejection of equipment for above reasons, it is obvious that the overall project schedule will be affected. To minimize the loss due to such an occurrence, the **PURCHASER** retains the right to use as best as possible, the faulty equipment until new replacement arrives at site. Note should be taken that as the faulty equipment has not been taken over by the **PURCHASER**, the responsibility for it lies entirely with the **SUPPLIER**. During this period, the **SUPPLIER** shall not limit the use of the faulty equipment, except for reasons of safety during operation, both of personnel and the equipment.

2.24 PURCHASER's right to withhold payment

PURCHASER shall have the right to withhold or nullify the whole or a part of any application of **SUPPLIER** for payment to such extent as may be necessary to protect **PURCHASER** from sustaining any loss on account of:

- a. short supply not made good by **SUPPLIER**
- b. defective supply not rectified / made good by **SUPPLIER**
- c. defective work not remedied / replaced by **SUPPLIER** and to release the amount withheld after fulfillment by **SUPPLIER**

2.25 Training of PURCHASER's personnel

2.25.1 If considered necessary by the **PURCHASER**, the **SUPPLIER** shall undertake to train, the **PURCHASER's** engineering personnel (two persons) at their works / their sub-contractors' works without any additional liability to the **PURCHASER**. These engineering personnel shall be given special training in the shops, where the equipment will be manufactured and where possible, in any other plant where equipment manufactured by the **SUPPLIER** is under installation, operation or testing to enable these personnel to become familiar with the equipment being furnished by the **SUPPLIER**. The period of training shall be a minimum of 15-days.

2.25.2 All traveling expenses for the engineering personnel to be trained will be borne by the **PURCHASER**. Accommodation at the place of training, food and local travel facilities shall be provided by the **SUPPLIER**. These engineering personnel while undergoing training shall be responsible to the **SUPPLIER** for discipline.

2.26 Expediting

When deemed advisable, this contract shall be subjected to physical expediting by the **PURCHASER / CONSULTANT** who shall be granted access to any and all parts of **SUPPLIER's** or the **SUB-SUPPLIER's** plant and office involved in the manufacture or processing of the contract.

Expediting performance by the **PURCHASER's** representative shall in no way relieve the **SUPPLIER** of delivery obligations under the terms of the contract.

2.27 Suspension of work & extension of time

The **SUPPLIER** shall, if ordered in writing by the **PURCHASER** or their representative, temporarily suspend the work or any part thereof for such period and such time as so ordered and shall not after receiving such written orders, proceed therewith. In the event of suspension of work for a prolonged time by the **PURCHASER**, for the consequent idle time for the **SUPPLIER**, the **SUPPLIER** shall be compensated based on mutual agreement. The **SUPPLIER** shall not be responsible for the same, provided that the suspension was not consequent to any default / failure on the part of the **SUPPLIER** and the contractual delivery schedule shall be suitably extended after mutual discussion.

2.28 Sequence of delivery

The **SUPPLIER** shall deliver the goods as per the terms and conditions of the contract. Delivery terms are meant to be binding and essential. All materials shall be dispatched as per the agreed sequential order, suitable for erection progress at site. The delivery schedule shall also, indicate the approximate value of the major equipments. No deviation from the agreed sequence is allowed without **PURCHASER's** written approval. In case of deviation, the **PURCHASER** shall have the right to accept the supply but withhold the payment till the agreed date for the delivery of such material. If the delivery of any items as per the delivery schedule is delayed, the delivery of the subsequent items shall not be held up on this account.

2.29 Load data

SUPPLIER shall be responsible for correctness of the load data furnished by them to the **PURCHASER** for civil foundations.

In the event of notice of defects in the civil work, due to incorrect data furnished by the **SUPPLIER**, the cost incurred for redoing / rectifying, shall be borne by the **SUPPLIER**.

2.30 Quality assurance and Quality control

2.30.1 Quality Assurance (QA) shall mean the organizational set up, procedures as well as test, methods and facilities developed by **SUPPLIER** in order to assure that all goods leaving **SUPPLIER's**/ their **SUB-SUPPLIER's** shops are of the highest quality i.e., equal or exceeding the requirement specified by the **PURCHASER**.

2.30.2 Quality Control (QC) shall mean all the tests, measurements, checks and calibrations to be carried out in vendor's shop in order to compare the actual characteristics of the goods with the specified ones, as well as the documentation (certificates, records) containing the data or result of these activities.

2.30.3 The **SUPPLIER** shall submit a detailed procedure for quality control and quality assurance. The **PURCHASER** reserves the right to order for the technical audit of quality control and quality assurance systems followed by the **SUPPLIER** / **SUB-SUPPLIER**.

2.31 Dispatch Notice

SUPPLIER shall notify **PURCHASER** by E-mail, 7-days before the expected date of delivery of a consignment, date of readiness of equipment for shipment, total gross weight and total volume.

III. TERMS & CONDITIONS FOR THE ERECTION & COMMISSIONING SERVICES CONTRACT

1. GENERAL CONDITIONS OF CONTRACT FOR SERVICES

1.1 Use of contract documents and information

- 1.1.1 The CONTRACTOR shall not, without the OWNER's prior written consent, disclose the contract, or any provision thereof, or any specification, drawing, pattern, sample or information furnished by or on behalf of the OWNER in connection therewith, to any person other than a person employed by the CONTRACTOR in the performance of the contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purposes of such performance.
- 1.1.2 The CONTRACTOR shall not, without the OWNER's prior written consent, make use of any document or information specified in clause-1.1.1¹ above, except for purposes of performing the contract.
- 1.1.3 Any document other than the contract itself, specified in clause-1.1.1 above, shall remain to be the property of the OWNER and shall be returned (in all copies) to the OWNER, on completion of the CONTRACTOR'S performance under the contract, if so required by the OWNER.

1.2 Change in the contract

- 1.2.1 The OWNER may at any time, by written notice to the CONTRACTOR make changes within the general scope of the service contract.
- 1.2.2 Upon notification by the OWNER of such change/s, the CONTRACTOR shall submit to the OWNER an estimate of costs for the proposed change/s, including any change in the schedule of payments, within ten (10) calendar days of the receipt of notice, and shall include an estimate of the impact, if any, on the time schedule under the contract, as well as the detailed schedule for the execution of the change, if applicable.
- 1.2.3 The CONTRACTOR shall not perform changes in accordance with clause-1.2.1 above until the OWNER has authorized a change in writing on the basis of the estimate provided by the CONTRACTOR as described in clause-1.2.2 above.
- 1.2.4 Changes mutually agreed upon shall also constitute a part of the work under this contract, and the provisions and conditions of the contract shall apply to said changes.
- 1.2.5 In the event the OWNER shall cause the CONTRACTOR to expend labour or consumables, or both, of any nature in order to provide the OWNER with information upon which to base a decision as to whether a change should be ordered, the OWNER shall reimburse the CONTRACTOR for the total costs related to supplying such information.

¹ Any reference to the clause numbers made within section III shall be construed to be the reference with in Section III only.

1.2.6 Except with the express permission of the **OWNER**, the installation of goods shall not be delayed pending agreement of costs or schedules affected by minor changes.

1.3 Contract Amendments

1.3.1 Subject to clause-1.2, no variation in or modification of the conditions and terms of the contract shall be made except by written amendment signed by the parties.

1.4 Sub-contracts

1.4.1 The **CONTRACTOR** shall not sub-contract all or any part of the contract without notifying the **OWNER** in writing, of the details of the sub-contractor and the work sub-contracted. Only approved sub-contractors of the **CONTRACTOR** shall be employed.

1.4.2 The **CONTRACTOR** guarantees that any and all sub-contractors of the **CONTRACTOR** for performance of any part of the work under the contract will comply fully with the terms of the contract applicable to such part of the work under the contract.

1.5 Country of Origin

All services provided under this contract shall be within India.

1.6 Inspection and tests

1.6.1 The **OWNER** or their representative or a reputed third party inspection agency nominated by the **OWNER**, shall have the right to inspect the work being carried out under this contract. However, for IBR items, third party inspection is not necessary. The Special Conditions of Contract or the specification or both shall specify what inspections and tests the **OWNER** requires and where they are to be conducted. The **OWNER** shall notify the **CONTRACTOR** in writing of the identity of representatives or third party agency retained for these purposes.

1.7 Contract performance security (Retention money)

1.7.1 The **CONTRACTOR** shall cause contract performance security to be furnished to the **OWNER** for the amount of ten percent (10%) of the contract price by means of a Bank Guarantee. Such performance security shall be provided, in the form satisfactory to the **OWNER**, within fifteen (15) days after the **CONTRACTOR**'s receipt of the notification of award of contract. The period of validity of the contract performance security shall be until the completion of work under the contract one year.

1.7.2 The proceeds of the performance security shall be payable to the **OWNER** as compensation for any loss resulting from the **CONTRACTOR**'s failure to complete the work under the contract. The **CONTRACTOR** shall cause the validity period of the performance security to be extended for such period(s) as the work schedule may be extended pursuant to clause-1.11.2.

1.7.3 The performance security shall be in the following form:

A bank guarantee, issued by a bank acceptable to the **OWNER**, in a form acceptable to the **OWNER**.

1.7.4 The performance security will be discharged or returned or both by the OWNER not later than thirty (30) days following the date of satisfactory commissioning and acceptance.

1.7.5 The bank guarantee as per clause-1.7.3 above, shall be enforceable by the OWNER in case the CONTRACTOR does not commence or continue to work as per the schedule / bar chart by giving 30-days' notice.

1.8 Indemnity

1.8.1 The **CONTRACTOR** and the **OWNER** shall indemnify and hold harmless each other from and against such claims and liabilities as provided in the Special Conditions of Contract.

1.8.2 Notwithstanding anything in this contract to the contrary, it is agreed that neither the **CONTRACTOR** nor the **OWNER** shall be held liable to the other party for loss of production, loss of profit, loss of use or any other indirect or consequential damage, except losses due to defects due to improper handling and installation.

1.9 Insurance

1.9.1 Necessary insurance cover shall be taken by the **CONTRACTOR** as mentioned in the Special Conditions of contract.

1.9.2 Without limiting the **CONTRACTOR's** liability (limited only to the contract price) the **CONTRACTOR** shall ensure that their sub-contractors also procure such additional insurance cover as specified above.

1.9.3 The **CONTRACTOR** shall ensure that further insurance covers as specified in the Special Conditions of the contract are also arranged.

1.10 Payment

1.10.1 The PURCHASER will pay the CONTRACTOR directly for the costs of loading, transportation to site, transit insurance, unloading, storage at site, installation and commissioning services as per **Appendix – I**.

1.10.2 The Price shall be firm and no escalation whatsoever is applicable till the completion of the contract.

1.10.3 All Payments shall be made in Indian rupee only.

1.10.4 Subject to clause-1.2 of the General Conditions of Contract and as provided for in the price schedule, price charged by the CONTRACTOR for services under the contract shall not vary from the prices agreed by the CONTRACTOR and given in the price schedule.

1.10.5 Payment for all invoices shall be made within 30-days from the date of submission and acceptance of the invoices by the OWNER.

1.10.6 The **CONTRACTOR's** invoices shall be paid in full inclusive of taxes and duties, after the deduction of advances and the retention money. The **OWNER** shall not make any deductions against any claims he may have on the **CONTRACTOR** as per the contract terms, unless the details of claim have been communicated to the **CONTRACTOR** in advance.

1.11 Extension in the CONTRACTOR's performance

1.11.1 Installation and commissioning of the goods shall be made by the **CONTRACTOR** in accordance with the time schedule, pursuant to the Special Conditions of Contract.

1.11.2 The **CONTRACTOR** may claim extension of the time limits as set forth in the work schedule in case of:

- a. Changes ordered by the **OWNER** pursuant to clause-1.2;
- b. Delay in any service which is to be provided by the **OWNER** (services provided by the **OWNER** shall be interpreted to include all approvals by the **OWNER** under the contract as well as access to the site);
- c. Delay in timely fulfillment of obligation by the Purchaser.
- d. Delay in timely release of payments by the Purchaser.
- e. Suspension, variations or any other reasons of delay, which is not attributable to the supplier.
- f. Force majeure pursuant to clause-1.17; and
- g. Delay in performance of work caused by orders issued by the **OWNER**.

The Supplier shall be entitled to extension to time for the corresponding period besides escalation/increase in price on account of delays, which shall be mutually discussed and agreed.

The **CONTRACTOR** shall demonstrate to the **OWNER**'s satisfaction that they have used their best endeavors to avoid or overcome such causes of delay, and the parties will mutually agree upon remedies to mitigate or overcome such causes of delay. The extension of time limit shall be mutually discussed and agreed.

1.12 Termination for Default

1.12.1 The **OWNER** may, without prejudice to any other remedy for breach of contract, by written notice of default sent to the **CONTRACTOR**, terminate the contract in whole or in part:

- a. If the **CONTRACTOR** fails to deliver any or all of the services within the time period(s) specified in the contract, or any extension thereof granted by the **OWNER**, pursuant to clause-1.11; or
- b. If the **CONTRACTOR** fails to perform any other obligation(s) under the contract; and if the **CONTRACTOR**, in either of the above circumstances, does not cure their failure within a period of ten (10) calendar days (or such reasonable period as the **OWNER** may authorize in writing) after receipt of a notice of default from the **OWNER** specifying the nature of the default(s).

1.13 Termination for Insolvency

1.13.1 The **OWNER** may at any time terminate the contract by giving written notice to the **CONTRACTOR**, without compensation to the **CONTRACTOR**, if the **CONTRACTOR** becomes bankrupt or otherwise insolvent. Notwithstanding the above, such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the **OWNER**.

Provisions for termination for insolvency shall apply viz-a-viz to both the parties. In the event of termination for insolvency by the Supplier, provisions for termination for convenience by the Purchaser shall apply.

1.14 Termination for Convenience

- 1.14.1 The **OWNER** may, by written notice to the **CONTRACTOR**, terminate the contract, in whole or in part, at any time for their convenience. The notice of termination shall specify that termination is for the **OWNER**'s convenience, the extent to which performance of work under the contract is terminated, and the date upon which such termination becomes effective.
- 1.14.2 For the extent of work terminated, the **OWNER** shall pay an agreed amount for partially completed services by the **CONTRACTOR** for the purpose of the contract, together with a reasonable allowance for overhead and profit and a reasonable compensation, based on mutual discussions, for the financial commitments made by the **CONTRACTOR** for fulfilling their obligations under this contract.

1.15 Resolution of disputes

- 1.15.1 The **OWNER** and the **CONTRACTOR** shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the contract.
- 1.15.2 If, after thirty (30) days from the commencement of such informal negotiations, the **OWNER** and the **CONTRACTOR** have been unable to resolve amicably a contract dispute, either party may require that the dispute be referred for resolution by arbitration by the mechanism described in the Special Conditions of Contract. The award shall be final and binding on the parties.

1.16 Jurisdiction for legal proceedings

- 1.16.1 The contract shall be governed by and interpreted in accordance with the Indian laws. No suit or any proceedings in regard to any matter arising in any respect under this contract shall be instituted in any court other than the court Patna. No other court shall have jurisdiction to entertain any suit or proceedings even though part of the cause of action might arise within their jurisdiction.

1.17 Force majeure

- 1.17.1 In the event that the **CONTRACTOR** or any of their sub-contractors, or the **OWNER** delays performing any of their respective obligations under the contract, and such delay is caused by force majeure, by acts of God / Government in its sovereign capacity, including but not limited to war, civil insurrection, riots, strikes, fires, floods, epidemics, earthquakes, quarantine restrictions and freight embargoes, such delay may be excused as provided in clause-1.11, and the period of such delays, or a period mutually discussed and agreed, may be added to the time of performance of the obligation delayed.
- 1.17.2 If a force majeure situation arises, the **CONTRACTOR** shall promptly notify the **OWNER** in writing within 15 days of such condition and the cause thereof along with documentary evidence. Unless otherwise directed by the **OWNER** in writing, the **CONTRACTOR** shall continue to perform their obligations under the contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the force majeure event.
- 1.17.3 In no event shall, a force majeure event excuse the obligations of a party, if those obligations are required to have been completely performed, prior to the occurrence of that force majeure event.

1.18 Assignment

1.18.1 The **CONTRACTOR** shall not assign to any other agency, in whole or in part, their obligations to perform under the contract, except with the **OWNER**'s prior written consent.

1.19 Contract language

1.19.1 The **CONTRACTOR** hereby represents that it has sufficient knowledge of the English language to understand the contract fully. The contract shall be in the English language, and all documentation related hereto will also be in the English language, except if otherwise specifically agreed in writing between the parties.

1.20 Taxes and duties

1.20.1 The **CONTRACTOR** shall be entirely responsible for all taxes, duties and other such levies including entry tax and works contract tax imposed for the performance of the services as per the contract. The **CONTRACTOR** shall indicate the same in the price schedule.

1.21 Headings

1.21.1 Headings, whether of clauses or of other parts of the contract, are for reference only and are not to be construed as part of the contract.

1.22 Waiver

1.22.1 Failure of either party to insist upon strict performance by the other party of any provision of the contract shall in no way be deemed or construed to affect in any way the right of that party to require such performance.

2. SPECIAL CONDITIONS OF CONTRACT FOR SERVICES

2.1 Definitions

In this document, the words and phrases listed shall have the meaning specified against each word or phrase. Words imparting singular shall include plural and vice versa and words imparting the masculine gender shall include feminine gender and words imparting persons shall include bodies corporate.

- a. "The **OWNER**" means M/s **HPCL Biofuels Ltd (HBL), Village Suguali, East Champaran, Bihar**
- b. "The **CONSULTANT**" means M/S. MITCON Consultancy & Engineering Services Ltd., having their Registered Office at First Floor Kubera Chambers, Shivajinagar Pune 411 005 Maharashtra State.
- c. "The **CONTRACTOR**" shall mean the individual or firm providing the services under this contract.
- d. "The **GOODS/EQUIPMENT/PLANT**" shall mean all of the equipment, machinery and/or other materials which the **OWNER** is required to provide to the **CONTRACTOR** under the contract.
- e. "The **CONTRACT**" shall mean the Contract agreement entered into between the **OWNER**, and the **CONTRACTOR**, as recorded in the contract, signed by both the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.
- f. "The **SUB-CONTRACTOR**" shall mean any individual or firm or company, to whom part of the contract has been sublet by the **CONTRACTOR** with the consent of the **OWNER**.
- g. "The **INSPECTOR**" shall mean any person or agency nominated by the **OWNER**, from time to time, to inspect equipment stage wise including final stage, at job site as per the terms of the contract.
- h. "**SUB-CONTRACT**" shall mean order placed by the **CONTRACTOR** for any portion of the work, with the necessary consent of **OWNER**.
- i. "**CONTRACT PRICE**" shall mean the 'consideration' payable by the **OWNER** directly to the **CONTRACTOR** as per the agreement and desire of **CONTRACTOR** for the full and proper performance of contractual obligations under the contract between the **OWNER** and the **CONTRACTOR**.
- j. "**DELIVERY**" shall mean the completion of all erection work within the completion date specified in the contract, vide clause 2.7.2 of the Special Conditions of Contract.
- k. "**SITE**" shall mean and include the land and other places on, into or through which the works and the related facilities are to be erected or installed, at the **PURCHASER's** site at Village Suguali, Est Chaparan, Bihar.
- l. "**DRAWINGS**" shall mean the technical specification which shall include engineering drawings, sketches showing plans, sections and elevations related to the contract together with modifications and/or revision thereto.
- m. "**SPECIFICATION**" shall mean and include schedules, detailed description, statements of technical data, performance characteristics, standards (Indian as well as international) as applicable and specified

in the contract.

- n. “**ENGINEER/ENGINEER-IN-CHARGE**” shall mean the person so nominated by the **OWNER** for the time being or such other person as may be duly authorized and appointed in writing by the **OWNER** to act as site engineer for the purpose of the contract. In cases where no such engineer is so appointed, the word ‘engineer’ shall mean the **OWNER** or their duly authorized representatives.
- o. “**TESTS**” shall mean such process or processes to be carried out by the **CONTRACTOR** as are prescribed in the contract or considered necessary by **CONSULTANT / OWNER** and **CONTRACTOR** together after mutual discussions, in order to ascertain quality, workmanship, performance and efficiency of equipment or part thereof.
- p. “**APPROVAL**” shall mean and include the written consent, either manuscript, type-written or printed statement, under signature or seal, as the case may be, of the **OWNER/CONSULTANT** or their authorized representative on documents, drawings or other particulars in relation to the contract.
- q. “**DATE OF CONTRACT**” shall mean the date on which the parties have signed the contract.
- r. “**MONTH**” shall mean the calendar month.
- s. “**DAY AND DAYS**” shall mean the calendar day or days of twenty four (24) hours each.
- t. “**WEEK**” shall mean a continuous period of seven (7) days.
- u. When the words ‘Approved’, ‘Subject to Approval’, ‘Satisfactory’, ‘Required’, ‘As Directed’, ‘Where Directed’, ‘Determined By’, ‘Accepted’, ‘Permitted’, or words or phrases of like importance are used, the approval, judgement, direction etc., are understood to be a function of **OWNER / CONSULTANT**
- v. “**WORK**” shall mean all the services to be rendered by the **CONTRACTOR** under the contract.
- w. “**START UP**” shall mean the time period required to bring the equipment covered under the contract from an inactive condition, when construction is essentially complete, to the state ready for trial operation. The start up shall include the preliminary inspection and checkup of equipment and supporting sub-system, initial operation of the complete equipment to obtain necessary pre-trial data, perform calibration and corrective action and adjustment prior to trial operation period.
- x. “**COMMISSIONING**” shall mean the first operation of the equipment (after all initial adjustments, trials, cleaning and re-assembly required at site if any, have been completed) and the equipment is ready for commercial use.
- y. “**SATISFACTORY COMMISSIONING for the purpose of claiming retention money**”, means the continuous operation of the equipment to the full capacity and establishment of its strict performance of the contractual requirement.
- z. “**THE ZERO DATE OF THE CONTRACT**” shall be issue of LOI OR date of Contract Signed

2.2 Scope of the contract

- 2.2.1 The **CONTRACTOR**’s scope of work comprises of the transportation of the goods to site from the

equipment supplier's works, unloading, storage at the site, handling, installation, commissioning and performance testing of plant and machinery as defined in the specification, with all their accessories, fittings, supports and all the auxiliary equipment and material as detailed in the specification.

- 2.2.2 Wherever it is stated in this contract that such and such service is to be provided, it shall be understood that the same shall be effected/carried out by the **CONTRACTOR** within the contract price, unless a different intention is specifically and expressly stated herein or otherwise explicit from the context.
- 2.2.3 The **CONTRACTOR** shall ensure that the work shall be of first-class quality and shall be performed:
- a. with due diligence and efficiency.
 - b. in accordance with the provisions of the Contract agreement and the time schedule indicated in this Contract.
- 2.2.4 The **CONTRACTOR** shall at all times ensure that the work is carried out by fully qualified and experienced personnel to warrant the performance of the work in accordance with this Contract.
- 2.2.5 The **CONTRACTOR's** obligations towards the contract include besides erection and commissioning of Incineration Boiler and auxiliaries with BoP, performance testing, trial operation, reliability run and handing over of the Incineration boiler & Aux. with BoP to the **OWNER**.
- 2.2.6 Training of the **OWNER's** personnel at the site.

2.3 Codes & Standards

The services performed under this contract shall conform to the codes and standards mentioned in the technical specification, and, when no applicable standard is mentioned, to the authoritative codes and standards and such standards shall be the latest issued by the concerned institution. In the event that the language of such codes and standards happens to be anything other than English, the **CONTRACTOR** shall furnish the English translation of all such codes and standards proposed to be used in the contract. Such English translations shall be provided to the **OWNER / CONSULTANT** within the first four (4) weeks from the date of the contract.

2.4 Workmanship

The workmanship shall meet the requirement of relevant standards and good engineering practices.

2.5 Statutory approval for work

- 2.5.1 The application for submission to inspector, or any other authority required as per statutory rules and regulations of State / Central governments along with copies of required certificates complete in all respects shall be prepared by the **CONTRACTOR**. At the site the primary responsibilities for statutory approvals and liaison with government authorities for approvals shall be with the **OWNER** and the **CONTRACTOR** shall provide all necessary assistance to the **OWNER** in this regard.

The **PURCHASER** shall pay the statutory inspection and other fees and charges payable under the terms of any act of Regulation in respect of the installation, operation or use of machinery and

equipments. But the follow-up work for get the approval is to be done by the SUPPLIER at their cost. The PURCHASER will extend all co-operation in this respect.

- 2.5.2 Any change / addition required to be made to meet the requirement of the statutory authorities, if such changes /additions of the statutory requirement come into force before the date of signing of the contract, shall be carried out by the **CONTRACTOR** free of charge.

The changes/additions required, consequent to the statutory regulations coming into force after the date of signing of the contract shall be paid by the **OWNER** after mutual agreement. The inspection and acceptance of the work by statutory authorities shall, however, not absolve the **CONTRACTOR** from any of their responsibilities under the contract.

2.6 Testing and inspection

- 2.6.1 The equipment will be inspected and where practicable, submitted to such tests at site as deemed necessary by the **OWNER / CONSULTANT**.

- 2.6.2 Where the **OWNER**'s representative is present to witness the tests, the test certificate shall be signed by him on successful completion of tests. In case the **OWNER** is not satisfied with the tests, he shall within seven days of his witnessing the tests, inform the **CONTRACTOR**, in writing, of any objection with regard to any equipment and workmanship with reference to the contractual provisions. The **CONTRACTOR** shall give due consideration to such objections and shall either make the modification that may be necessary to meet the said objections or shall confirm in writing to the **OWNER** giving necessary reasons, that no modifications are necessary to comply with the contract. However, any defect noticed at the time of installation or after installation and commissioning shall be rectified by the **CONTRACTOR** free of cost.

- 2.6.3 The extent of **OWNER**'s inspection could be mutually discussed and agreed between the **OWNER** and the **CONTRACTOR**.

2.7 Time schedule

- 2.7.1 Timely installation and commissioning of the plant and equipment shall be the essence of the contract. The **CONTRACTOR** shall so organize their resources and perform this work as to complete it not later than the date given in the following clause. The schedule of the equipment delivery by the equipment supplier will be furnished to the **CONTRACTOR** two (2) months before the first consignment is ready for dispatch. The **CONTRACTOR** shall mobilize their resources for the transportation of the deliverables from the **SUPPLIER**'s or their **SUB-SUPPLIER**'s works to the site and carefully store the equipment and materials at the site prior to the starting of the erection work.

- 2.7.2 The following shall be the schedule for the completion of various milestone activities for this package. The **CONTRACTOR'S** time schedule shall strictly conform to this schedule.

Milestone activity	Completion date
1. Engineering Activities 2. Completion of Supply 3. Commencement of erection 4. Completion of commissioning	To suit commissioning within 12-months from zero date for Incineration Boiler & Aux. with BoP i.e. date of issue of LOI/PO, whichever is earlier

2.7.3 If the situation warrants, on account of any delay in the performance of the services, the **CONTRACTOR** shall air lift the equipment to meet the delivery commitment. All expenditure towards such air lifting, including tax implication if any, shall be to the **CONTRACTOR's** account, in case the delay in performance of services is directly attributable to the **CONTRACTOR**.

2.7.4 Time schedule network/bar chart

2.7.4.1 The **CONTRACTOR** shall submit to **OWNER / CONSULTANT**, their time schedule regarding the erection and commissioning of the equipment and materials as well as information on their sub-contracts to be placed with third parties, including the dates on which the **CONTRACTOR** intends to issue such sub-contracts.

2.7.4.2 The time schedule will be in the form of a network or a bar chart clearly indicating all main or key events regarding transportation, erection and commissioning.

2.7.5 Progress trend chart / monthly report

2.7.5.1 **CONTRACTOR** shall report monthly on the progress of the execution of contract and achievement of targets set out in time bar chart.

2.7.5.2 The progress will be expressed in percentages as shown in the form of progress trend chart.

2.7.5.3 The monthly reporting will be the updating of the progress trend chart.

2.7.5.4 The progress reports shall be submitted once in every fortnight till the completion of the contract.

2.7.5.5 The progress report shall further compare actual versus projected completion dates as well as describe current and anticipated problems and delaying factors, if any, and corrective action taken or proposed to be taken without in any way relieving or affecting the **CONTRACTOR's** responsibility to complete the services within the stipulated dates.

2.8 Liquidated damages for delay in time schedule

The **CONTRACTOR** shall endeavour to complete their scope of work within the time specified in the contract. It may be noted that "time is the essence of this contract", subject to clauses-1.11 and 1.17 of the General Conditions of Contract. If the **CONTRACTOR** fails to install and commission any or all of the goods within the time period(s) specified in the contract for services, the **OWNER** shall, without prejudice to the other remedies under the contract, deduct from the contract price, as liquidated damages, a sum equivalent to 0.5% of the total contract price for weekly of delay until actual performance, up to a maximum deduction of 5% of the total contract price, the total contract price being inclusive of subsequent modifications and price escalation, if contractual. Once the maximum is reached, the **OWNER** may consider termination of the contract.

2.9 Indemnity

2.9.1 The **CONTRACTOR** shall indemnify and hold harmless the **OWNER / CONSULTANT** from all claims, losses, demands, causes of action or suits arising out of the services and the labour furnished by them.

2.9.2 The **CONTRACTOR** shall indemnify the **OWNER** in respect of all actions, suits, claims and demands

brought or made against **OWNER** by the workmen of the **CONTRACTOR** or any other person or persons or government authorities whomsoever, in connection with the work or in respect of any matter or thing done or omitted to be done by the **CONTRACTOR** in the execution of or in connection with the work, notwithstanding that all reasonable and proper precautions may have been taken by the **CONTRACTOR**, and against any loss or damage to **OWNER** in consequence of any action or suit being brought against **OWNER** for anything done or committed to be done in connection with the execution of the work.

- 2.9.3 The **CONTRACTOR** shall reinstate all damages of every sort, so as to deliver the whole of the contract work complete and perfect in every respect, within the stipulated time.
- 2.9.4 The **CONTRACTOR** shall ensure compliance with all statutes, laws, rules and regulations of the Central or State governments or any other authority, such as the Workmen Compensation Act, 1923, Payment of Wages Act, Minimum wages Act, 1948, Employees State Insurance Act, Employees Provident Fund Act, etc., and any of the statutory modifications thereof in connection with employees engaged by them or their **SUB-CONTRACTORS** in the work.
- 2.9.5 **CONTRACTOR** shall conform to the provisions of Indian Boiler Regulations (as applicable), Indian Factories Act, Indian Electricity Rules etc. relating to the work and to the regulations and by laws of any authority, if required.

2.10 Insurance

- 2.10.1 The **CONTRACTOR** is responsible for comprehensive risk, insurance including storage-cum erection insurance charges of all machinery and equipments, other consumables, handed over by the owner to the **CONTRACTOR**. The insurance policies in respect thereof shall be arranged by the **CONTRACTOR** at such premium rates with such insurance companies as may be approved by the **OWNER** and kept in full force and effect until commissioning of the said plant.
- 2.10.2 The **CONTRACTOR** shall also lodge claims for damage / loss of material or equipments during storage, erection and commissioning. All realization of claims from the insurance company, whether in the name of the **OWNER** or the **CONTRACTOR**, shall be to the account of the **CONTRACTOR**.
- 2.10.3 The **CONTRACTOR** shall also maintain an insurance policy against all claims which may be made upon the **OWNER** whether under the Workmen's Compensation Act or any other statute in force during the currency of the contract or at common law in respect of any employee of **CONTRACTOR** or their **SUB-CONTRACTORS**.

2.11 Licenses and permits

The **CONTRACTOR** shall procure or render all the assistance to the **OWNER** to procure, as the case may be, necessary permits, certificates and licenses such as from the Chief Inspector of Boilers (as applicable), Electrical Inspectorate, Inspector of Factories, and such other statutory bodies required by virtue of all applicable laws, regulations, ordinances and other rules in effect at the place where any of the work is to be performed and the **CONTRACTOR** shall further agree to hold the **OWNER** harmless from liability or penalty which may be imposed by reason of asserted or established violation of such laws, regulations, ordinances or other rules.

2.12 Arbitration

If at any time there should be any question, dispute, difference between the parties in respect of any matter arising out of or in relation to the contract, either party may give to the other party notice in writing of the existence of such question, dispute or difference, and the same shall be referred to the arbitration of panel of Engineers appointed by each party as per prevailing arbitration act.

The award of the Arbitrator shall be final and binding of the parties and be accepted by them. This reference to the Arbitrator shall be deemed to be reference, under the provisions of the Arbitration Act, 1996 and the rules made there under and any statutory modifications or recent amendment thereof that may be made from time to time and actually in force at the time of the reference. The cost of arbitration shall be borne by the parties as may be decided upon by the Arbitrator.

2.13 Instructions, Directions and Correspondence

2.13.1 The services described in this contract are to be provided according to the specification and conditions specified in the contract.

2.13.1.1 All instructions and orders to **CONTRACTOR**, excepting what is herein provided shall be given by **OWNER** and/or **CONSULTANT**, in writing.

2.13.1.2 All the services shall be provided under the direction of and to the satisfaction of **OWNER/CONSULTANT**.

2.13.1.3 All communications from **CONTRACTOR**, including technical/commercial clarifications and/or comments shall be addressed to **OWNER** with a copy to **CONSULTANT** and shall always bear reference to the contract.

2.13.2 Correspondence on technical and commercial matters shall be dealt in separate letters and each copy of the letter shall be complete with all annexures.

2.14 Excess Materials

2.14.1 To expedite work, the **CONTRACTOR** may keep extra consumable materials in quantities at their cost more than that required for erection, installation and commissioning of the plant and equipment. Such excess material shall be treated as the property of the **CONTRACTOR**.

2.14.2 The **CONTRACTOR** has to take all care for the safety of such materials and the **OWNER** is not responsible for any loss or damage to such materials.

2.15 Contract coordination procedure

2.15.1 The **CONTRACTOR** shall identify one of their senior executives as the contract coordinator. The contract coordinator shall liaison closely with **OWNER**'s executives and **CONSULTANTS** for the effective completion of the services within the stipulated time schedule.

2.16 Trial run and provisional take-over

- 2.16.1 After all the systems have been erected and commissioned and completely stabilized and proved safe, the **CONTRACTOR** in consultation with the **OWNER / CONSULTANT** shall offer concern equipment/ plant as a whole for continuous and safe operation as a “trial run” for 7-days. A “reliability run” at rated design load for 24-hours of uninterrupted operation shall also be undertaken during such “trial run”.
- 2.16.2 In case the trial operation is interrupted by default of the **CONTRACTOR** at any time then, and excepting any trivial tripping, it will be repeated from the beginning, after modification / adjustments / verifications by the **CONTRACTOR** as required and agreed by the **OWNER / CONSULTANT**.
- 2.16.3 After such safe, stable and successful trial run, the package shall be considered operationally reliable and commissioned, and be provisionally taken over by the **OWNER**.

2.17 Performance tests and final take over

The performance test on the unit shall be conducted within six (6) weeks from the date of commissioning. Upon successful completion of performance tests required by the **OWNER** as well as fulfillment of all other obligations by the **CONTRACTOR**, taking over certificate as a proof of final acceptance of the equipment/system will be issued by the **OWNER**. The taking over certificate shall not be unduly delayed without assigning any acceptable reason.

If the performance test could not be conducted within the five (5) month’s period owing to an intervening off-season, the test shall be conducted immediately after the starting and stabilization of the next cane crushing season, applying the internationally accepted ageing factors, failing which the conducting of performance test and any extension of performance bank guarantee will be mutually discussed.

2.18 Co-ordination with other agencies

Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the **CONTRACTOR**. Proper co-ordination with other agencies shall be the **CONTRACTOR**’s responsibility. In case of any dispute, the decision of the Engineer-in-charge shall be final and binding on the **CONTRACTOR**.

2.19 Setting out and leveling

The **CONTRACTOR**, wherever applicable, shall set out and level the works from the general grid of plot and bench marks furnished by the Engineer-in-charge and will be responsible for the accuracy of the same. The **CONTRACTOR** shall provide all instruments and proper qualified staff for checking their work. The **CONTRACTOR** shall protect survey benchmarks, reference lines and control points from damage or movement during work.

2.20 Loss due to non-compliance of instructions

Losses or damages occurring to the **OWNER** owing to **CONTRACTOR**’s failure to adhere to any of the instructions given by the Engineer / **OWNER** in connection with the contract execution shall be recoverable from the **CONTRACTOR**. The decision of the **OWNER** as to the compensation recoverable shall be final and binding on the **CONTRACTOR**.

2.21 Suspension of work & idle time extension

The **CONTRACTOR** shall, if ordered in writing by the **OWNER** or their representative, temporarily suspend the work or any part thereof for such period and such time as so ordered and shall not after receiving such written orders, proceed therewith. In the event of suspension of work for a prolonged time by the **OWNER** and the consequent idle time for the **CONTRACTOR**, the **CONTRACTOR** shall be compensated based on mutual agreement. The **CONTRACTOR** shall not be responsible for the same, provided that the suspension was not consequent to any default, failure on the part of the **CONTRACTOR** and the contractual time schedule shall be suitably extended after mutual discussions.

2.22 CONTRACTOR's site office

OWNER will provide available open space for the construction of their site office to the **CONTRACTOR** and such office shall be kept open by the **CONTRACTOR** at all reasonable hours to receive instructions, notices or other communications.

2.23 Site organization

The **CONTRACTOR** shall deploy adequately qualified and skilled personnel on the work, and the **CONTRACTOR** shall augment the site personnel as decided by the Engineer-in-charge depending on the exigencies of work.

2.24 Construction equipment

The **CONTRACTOR** without prejudice shall bear the overall responsibility to execute and complete the work as per specification and time schedule, progressively deploy adequate equipment and tools and tackles and augment the same as decided by the Engineer-in-charge depending on the exigencies of work so as to suit the construction schedule. No construction equipment shall be supplied by the **OWNER**.

All tools, tackles and consumables besides items like furniture's etc., shall be accounted for at the site's entrance and also at the **OWNER's** stores, by handing over a spare copy of the delivery challan by the **CONTRACTOR**.

2.25 CONTRACTOR's work force

2.25.1 Registration of contract and labour license

2.25.1.1 The **CONTRACTOR** shall have the responsibility to register the contract with local authorities as per the statutory requirement and shall also obtain necessary license from Factory Inspectorate in respect of the labour force employed by them.

- a. No child labour employment is permitted. No female worker will be permitted to work beyond 6.00 P.M. on any day.
- b. Every worker shall be given a weekly day of rest. Any work done on weekly rest days shall be duly compensated, by the **CONTRACTOR**.
- c. The **CONTRACTOR** shall maintain a register of wages-cum-muster roll.

2.25.1.2 The **CONTRACTOR** shall furnish adequate courteous and competent labour, (skilled, semi-skilled and un-skilled), watchmen, supervisors and engineers of all class for the duration of the

work, to maintain the progress of erection in accordance with the requirement of the schedule of completion.

2.25.1.3 It is important that the **CONTRACTOR** shall employ men known to be reliable and competent for the work

2.25.1.4 **CONTRACTOR** shall be personally present or employ atleast one competent representative (whose name shall have been previously communicated in writing to the **OWNER**) to supervise the erection of the equipment and carrying out of the work under the contract. This representative shall have full technical capability and complete administrative and financial powers to expeditiously and efficiently execute the work under the contract. The **OWNER** or **CONSULTANT** shall normally communicate directly with the said representative at site.

In case the above representative is found to be incompetent and / or non-coordinating by the **OWNER / CONSULTANT**, the **CONTRACTOR** shall replace him with a more competent person.

2.25.1.5 **CONTRACTOR**'s employees shall be provided with identification badges showing employee's name, **CONTRACTOR**'s name and project identification. All employees will be required to wear the badge during the time they are at project site. All workers, watchmen, supervisors, engineers and other staff at the work site shall be provided with safety helmets by **CONTRACTOR** and they shall wear it all the time they are at the work site.

2.25.1.6 **CONTRACTOR** shall ensure that they pay their men regularly their wages, overtime and other compensations. **CONTRACTOR** shall also furnish the **OWNER** at fortnightly intervals, a certificate that they have paid all the dues to their workmen.

2.25.1.7 In case, such payment is not regularly made by the **CONTRACTOR**, **OWNER** will be in the right to make such payments and deduct it from **CONTRACTOR**'s progress payment.

2.25.2 Registration of contract

If the number of workmen employed by the **CONTRACTOR** is more than nineteen (19), they are required to obtain a license from the competent authority as required under the contractors' and Labour (Regulations and Abolition) Act, after obtaining a certificate from the principal employer, to the effect that they have been awarded the contract. They are also required to give to the principal employer, the number of workmen proposed to be employed and produce the license for verification.

2.25.3 E.S.I

All workmen employed by the **CONTRACTOR** shall be covered under ESI immediately on appointment, by the **CONTRACTOR**.

2.25.4 Requirement under Factories Act

All workmen should be allowed to work not more than 9-hours a day and forty eight (48) hours a week. Weekly off on 1st day of the week (Sunday) or a substitute weekly off within 3-days before the 1st day of the week or after the 1st day of the week should be allowed to all the workmen. Overtime wages for working beyond the normal working hours should be given as per labour laws in force. Also overtime for the work on company's declared holidays should be given at the same rate. All the workmen should be allowed leave as per the Factories Act. In case the workmen have not availed leave during the period

of their work, they should be given wages in lieu of leave accrued to their credit at the time of leaving. The **CONTRACTOR** should maintain the Muster Roll, Register of Adult Workers, Overtime Register, Leave Register and submit the Registers to the principal employer for verification, and to the Factories Inspector, if applicable, for inspection, whenever he visits the factory.

2.25.5 Accident register If any accident occurs in the course of and arising out of employment, the **CONTRACTOR** should immediately inform **OWNER**'s representative with the details of the workmen. He should maintain the present and permanent addresses of all the workmen and the name of the person to whom information is required to be given in case of emergencies.

2.26 Safety code

2.26.1 General

CONTRACTOR shall adhere to safe construction practices and guard against hazardous and unsafe working conditions.

2.26.2 First aid and industrial injuries

2.26.2.1 The **CONTRACTOR** / their **Sub-CONTRACTORS** shall make arrangements for the treatment of their workmen for injuries sustained while on duty.

2.26.2.2 All major accidents shall be reported promptly to **OWNER**, and a copy of **CONTRACTOR**'s report covering each personal accident requiring the attention of a physician, shall be furnished to **OWNER** for their information.

2.26.3 **CONTRACTOR**'s barricades

2.26.3.1 **CONTRACTOR** shall erect and maintain barricades required in connection with their operation to guard or protect especially the following areas, if applicable with the scope of **CONTRACTOR**.

- a. Excavations
- b. Hoisting areas
- c. Areas considered hazardous by **CONTRACTOR** or **OWNER** or Engineer.
- d. **OWNER**'s existing property likely to be damaged by **CONTRACTOR**'s / their **SUB-CONTRACTOR**'s operations.

2.26.3.2 Barricades and hazardous areas with the battery limits, adjacent to normal routes of travel shall be marked by red flasher lanterns at nights.

2.26.4 Scaffolding

2.26.4.1 Suitable scaffolding shall be provided for workmen for all work that cannot safely be done from the ground or from solid construction except for such short period work as can be done safely from ladders. When a ladder is used, a helper shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder. The ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 verticals).

2.26.4.2 Working platform, scaffolding or staging more than 4-metres above the ground level or floor level shall be closely boarded, shall be of adequate width and shall have a guard rail properly

attached, at least one metre high above the floor or platform of such scaffolding or staging and extending along the entire length and the sides with only such openings as may be necessary for the entry of workmen and for handling of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

2.26.4.3 Every opening in the floor of a building or in a working platform shall be provided with suitable fencing whose minimum height shall be one metre to prevent the fall of persons or materials.

2.26.4.4 Safe-means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9-metres in length while the width between the side rails in rung ladder shall in no case be less than 30-cms for ladder upto and including 3-metres in length. For longer ladder this width should be increased atleast by 5-mm for each additional 300-mm of length. Spacing's of steps shall be uniform and not exceeding 30-cms.

2.26.4.5 Providing all the scaffoldings, staging, ladders etc., shall be the sole responsibility of the **CONTRACTOR**.

2.26.5 General safety rules

2.26.5.1 The **CONTRACTOR** shall use only tested equipment, tools, chains, ropes, etc. and shall periodically test them to ensure good working condition of such equipment, tools, chains, ropes, etc. Whenever required, valid test certificates shall be produced by the **CONTRACTOR** to the **OWNER**.

2.26.5.2 All necessary personnel safety appliances shall be kept available for the use of the persons employed at the site and maintained in conditions suitable for immediate use, and the **CONTRACTOR** shall take adequate steps to ensure proper use of safety appliances by those concerned.

- (i) All labour and supervisory personnel engaged in the erection work shall use safety helmets. All persons working at heights above 2-meters shall use safety belts and/or life lines.
- (ii) Workers employed on mixing asphaltic materials, cement and lime concrete/mortars shall use protective footwear and protective gloves.
- (iii) Those engaged in white washing and mixing or stacking of cement bags or any materials which are injurious to the eyes shall use protective goggles and hand gloves.
- (iv) Those engaged in welding and cutting work shall use protective face/eye-shields, hand gloves etc.
- (v) Stone breakers shall be provided with protective goggles and protective clothing, and seated at sufficiently safe intervals.
- (vi) Wherever men are employed on the work of lead painting, the following precautions should be taken:
 - a. No paint containing lead or lead product shall be used except in the form of paste or ready made paint.
 - b. Overalls and suitable face masks shall be provided for use by the worker when paint is applied in the form of spray or when a surface having lead paint dry is being rubbed or scraped.

2.26.5.3 Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to the following standard or conditions:

- (i) These shall be of good mechanical construction, sound material and adequate strength and shall be kept in good working order.
- (ii) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from defects.
- (ii) Every crane driver or hoisting appliance operator shall be properly trained and shall be conversant with safety regulation for using such equipment and appliances.
- (iii) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained. Every hoisting machine and all gears referred to above shall be clearly marked with the safe working load.

2.26.5.4 All work areas shall be kept reasonably clean for easy movement of men and material.

2.26.5.5 All approach roads shall be kept reasonably free for easy movement of vehicles.

2.26.5.6 Temporary water line shall be so routed as to avoid road crossing and wherever necessary, shall be laid underground. Temporary water storage tank built for construction use shall be properly fenced, wherever necessary. All such temporary water lines and water storage shall be the responsibility of the **CONTRACTOR**.

2.26.5.7 Temporary electrical sub-station, equipment, switchgear, cable and wire, lighting, etc. should be installed in accordance with standard electrical practices and regulations.

2.26.5.8 Temporary cable and wire, including welding cable, shall be so routed as not to clutter the work area. Temporary electrical line for power and lighting shall be run overhead and shall be high enough as not to hinder movement of men, materials and vehicles.

2.26.5.9 Temporary substation equipment, switchgear and distribution boards shall be adequately enclosed, duly protected against rain water, suitably earthed and properly identified with caution boards

2.26.5.10 All joints in the temporary wires and cables shall be properly insulated.

2.26.5.11 All supervisors, welders and electricians engaged in the work shall possess necessary and valid license / certificate of permit to carry out such work and shall be adequately skilled and acquainted with standard rules, regulations, codes and practices.

2.26.5.12 All operators of construction equipment and all tradesmen engaged in different construction activities shall be adequately qualified, experienced and proficient to carry out all their jobs in a safe manner.

2.26.5.13 First aid kits and personnel adequately trained to administer first aid shall be kept readily available for emergencies.

2.26.5.14 Portable hand-lamps being used by construction crew shall be preferably connected on 24-V supply. If 230-V hand lamps are used, the cables shall be heavily insulated and adequately protected,

earthed and bulbs should be protected with safety shields.

2.26.5.15 **CONTRACTOR** shall not use any structure or equipment erected or under erection for fastening, lifting or tying tackles or guy-ropes, which may impose loads which the structure or equipment are not designed to carry safely.

2.26.5.16 The **CONTRACTOR** shall not in the performance of the contract in any manner endanger safety or unlawfully interfere with the convenience of the Public.

2.26.5.17 All areas used for storing and installing inflammable materials shall be adequately identified and shall carry no smoking signs.

2.26.5.18 Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards. Hoisting appliances shall be provided with such means as to prevent the accidental descent of the suspended load. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary shall be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

2.26.5.19 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use.

2.27 **OWNER's Right to Withhold Payment**

OWNER shall have the right to withhold or nullify the whole or a part of any application of **CONTRACTOR** for payment to such extent as may be necessary to protect **OWNER** from sustaining any loss on account of defective work not remedied / replaced by **CONTRACTOR** and to release the amount withheld after fulfillment by **CONTRACTOR**.

2.28 **OWNER's Responsibilities**

2.28.1 The **OWNER** shall provide free of cost to the **CONTRACTOR** suitable open space for putting up the storage for equipment and materials, the **CONTRACTOR's** equipment, tools and tackles etc. brought to the site by the **CONTRACTOR** for the said erection, installation and commissioning work. The **CONTRACTOR** shall arrange for their own covered storage in the space provided to them. The transportation to the site, from the storage, shall be borne by the **CONTRACTOR**.

2.28.2 The **OWNER** shall also provide to the **CONTRACTOR** open office space (levelled, consolidated and with approach road) and drinking water at one point at site free of cost. Power (415-V AC, 4-W) and Telephone with STD facility also shall be provided as far as possible, but on chargeable basis.

2.28.3 The **OWNER** shall provide to the **CONTRACTOR** the required electrical power (415-V AC, 4-W) for erection & commissioning activities only, at one point free of cost. For fabrication activities the power will be provided on chargeable basis.

2.28.4 The **OWNER** shall provide free of cost to the **CONTRACTOR** adequate water supply at one point at factory site.

- 2.28.5 The **OWNER** declares that they have a clear and valid title free of encumbrances, to the site handed over to the **CONTRACTOR** for erection and commissioning of the said plant and that the **CONTRACTOR** shall have uninterrupted access to the use of the site to carry out the erection and commissioning services under this contract. Any breach of this warranty by the **OWNER** shall entitle the **CONTRACTOR** for extension of time proportionately for completion of the erection and commissioning services.
- 2.28.6 Accommodation for the **CONTRACTOR**'s executives shall be provided, if available.
- 2.28.7 Open space, duly levelled, consolidated with approach roads and drinking water at one point for labour sheds shall be provided by the **OWNER**.
- 2.28.8 Permission to use special tools and tackles supplied along with the equipment for erection and commissioning are to be returned in good working condition. In case these tools and tackles are damaged during erection, and becoming worn-out, they shall be replaced free of cost by the **CONTRACTOR**.
- 2.28.9 Supply of service water shall be the **OWNER**'s responsibility.
- 2.28.10 **OWNER** shall provide engineers and staff including skilled, semi-skilled and unskilled manpower for getting training in operation and maintenance during pre-commissioning and commissioning activities under the supervision of competent engineers and staff of the **CONTRACTOR**.
- 2.28.11 Workshop / lab facilities shall be extended to the **CONTRACTOR** by the **OWNER**, against written requests by the **CONTRACTOR** on chargeable basis, without affecting the **OWNER**'s work.
- 2.28.12 Fire fighting assistance, as available with **OWNER**, shall be provided when necessary.
- 2.28.13 Provision of all lubricants and chemicals required until commissioning shall be **SUPPLIER**'s responsibility.
- 2.28.14 Purchaser shall make all arrangements and provide all facilities and materials, adequate technical staff and labor, including skilled and unskilled for carrying out steam and water trial, commissioning and Performance Test.
- 2.28.15 Purchaser shall pay the statutory inspection and other fees and charges payable in respect of the installation, testing and commissioning including IBR fees.
- 2.28.16 Purchaser shall ensure supply of all chemicals, fuels, electric power, water etc. as required for erection and commissioning of Incineration boiler & Aux. with BoP Project except for first fill or flushing which will be in Supplier's scope.
- 2.28.17 Purchaser shall ensure proper drainage and sewage facilities at site, adequate space for construction material, equipments, labor hutment, etc., open store and covered storage space for tools and tackles, machinery and equipment and for storage of delicate items like instruments and motors etc.
- 2.28.18 Purchaser shall ensure that all required permissions, licenses and approvals such as site clearance, approvals for set up of Incineration boiler & Aux. with BoP project, pollution clearance and any other approval not specifically within the scope of the contractor are taken in such a manner so that site activities of the contractor are not stacked for want of these approvals etc.
- 2.28.19 Wherever approvals are required from Purchaser / Engineer the same shall be granted within 7 days except in the case of otherwise provided in the contract.

IV. PROJECT INFORMATION

1. PROJECT TITLE : EPC of Incineration Boiler & Aux. with BoP
2. PURCHASER : M/s HPCL Biofuels Ltd (HBL)
3. REGISTERED OFFICE : HPCL Biofuels Limited. House No.9,
Shree Sadan, 1st Floor, Patliputra
Colony, Patna - 800013
4. PURCHASER'S ADDRESS FOR COMMUNICATION: Village Suguali,
Near Suguali Railway Station, East Champaran, Bihar
Pranay@hpcl.in,
manojks@hpcl.in, abhishekkumar.singh2@hpcl.in
5. CONSULTANTS : MITCON Consultancy &
Engineering Services Ltd.
6. CONSULTANT'S ADDRESS FOR COMMUNICATION : First Floor, Kubera chambers
Shivajinagar, Pune - 5
Email: cpn@mitconindia.com
7. PLANT LOCATION : Village Suguali, Near Suguali Railway
Station, East Champaran, Bihar
8. NEAREST RAILWAY STATION : Suguali
9. NEAREST AIRPORT : Patna
10. PORT OF DISEMBARKATION : ---
11. AMBIENT TEMPERATURE (°C) : MAXIMUM : 45
MINIMUM : 05
PERFORMANCE DESIGN : 40
ELECTRICAL DESIGN : 50
12. RELATIVE HUMIDITY (%) : A. MAXIMUM : 70
B. MINIMUM : 40
C. DESIGN : 60
13. RAINFALL (ANNUAL AVERAGE) : 1200 mm

14. ALTITUDE : 73 M above M.S.L.
15. SEISMIC COEFFICIENT: As per IS: 1893 (Zone IV)
16. WIND A. DIRECTION : SW (May-Sept) & NE (Oct-April)
B. DESIGN WIND VELOCITY : As per IS: 875
17. Construction power (E&C Only) : 415V ($\pm 10\%$), 3 Phase, 4 Wire, 50 (47 to 51.5) Hz AC with effectively earthed neutral will be made available at only one point for free of cost. Power for fabrication purpose will be on chargeable basis. Bidder's scope shall include complete distribution beyond this point including hardware required for the same.

V. ANNEXURES

A. DRAFT BANK GUARANTEE FORMAT

This Guarantee made on the day of by the having its Branch at (hereinafter called “The Guarantor” which expression shall unless repugnant to the context or contrary to the meaning thereof, include its successors and assigns) of the one part.

IN FAVOUR OF M/s -----, a company, registered in the state of Karnataka under the companies act 1956, having its registered office at -----State (hereinafter called “The Purchaser” which expression shall unless repugnant to the subject or context, include their successors and assigns) of the other part.

WHEREAS M/s. (hereinafter called “The Seller” which expression shall unless repugnant to the subject or context include their legal representatives, administrators, successors or permitted assigns) had entered into an agreement vide letter of Intent dt. (hereinafter called “The said Agreement”) with the purchaser to design, prepare, supply, erect and commissioned the co-generation project for purchasers site at ----- (hereinafter called the Site) in accordance with the terms and conditions therein contained (hereinafter referred to as “The Said Plant”).

AND WHEREAS under the said agreement, the Purchaser required to pay to the sellers against security of a Bank Guarantee an advance payment of Rs. (Rupees:) representing of the contract price for the purpose of procurement of materials / equipments for the said plant. Such guarantee to be valid till the full advance amount is adjusted against the base price of the actual deliveries of machinery and equipment received at site.

AND WHEREAS before advance payment as aforesaid is made the Guarantor has, at the request of the Sellers, agreed to give the Guarantee as hereinafter contained.

NOW THIS DEED WITNESSES AS FOLLOWS

- 1). In consideration of the premises the Guarantor, hereby undertake to pay to the Purchaser within 30 days of demand and without demur such a sum not exceeding Rs.

The Purchaser may demand representing of the contract price, and if the Guarantor shall fall to pay the same within the said period, the Guarantor, shall also pay on the sum demanded interest at the Bank lending rate then prevailing reckoned from the date of demand till the date of payment. Provided that the liability of the Guarantor hereunder shall reduce to the extent of the advance adjusted according to of the said agreement.

- 2). The Guarantor shall pay to the Purchaser on demand the sum under Clause 1 above without demur and without requiring the Purchaser to invoke any legal remedy that may be available to them. it being understood and agreed **FIRSTLY** that the Purchaser shall be the sole judge of and as to whether the Sellers have committed any breach(es) of any of the terms and conditions of the said agreement and **SECONDLY** that the right of the Purchaser to recover from the Guarantor any amount due to the Purchaser shall not be effected or suspended by reasons of the fact that any dispute or disputes have been raised by the Sellers with regards to their liability or that proceedings are pending before any Tribunal, Arbitrator(s) or Court with regards thereto or in connection therewith, and **THIRDLY** that the Guarantor shall immediately pay the aforesaid guaranteed amount to the Purchaser on demand, it shall not be open to the Guarantor to know the reasons of or to investigate or to go into the merits of the demand or to question or to challenge the demand or to know any facts affecting the deemed, and **LASTLY**, that it shall not be open to the Guarantor to require proof of the liability of the Sellers to pay the amount, before paying the aforesaid guaranteed amount to the Purchaser.
- 3). This Guarantee shall come into force from the date release of payment hereof and shall remain valid till the full advance amount is adjusted under the said Agreement, which according to the terms and conditions of the said Agreement is stipulated to be adjusted against actual deliveries of the machinery and equipment at site, but if the actual deliveries as aforesaid have not been completed by the seller within the said period for any reasons whatsoever the Guarantor, hereby undertakes that the Sellers shall furnish a fresh or renewed guarantees on the Purchaser's Proforma for such further period as the Purchaser may intimate failing which the Guarantor shall pay to the Purchasers a sum not exceeding Rs. /-(Rupees:) or the residual amount of balance advance left after proportion to adjustment in accordance with Clause 1 above as the Purchaser may demand.

- 4) This Guarantee is in addition to and not in substitution for any other guarantee executed by the Guarantor in favour of the Purchaser on behalf of the Sellers.
- 5) The Sellers and Purchaser will be at liberty to vary and moodily the terms and conditions of the said agreement without effecting this guarantor is, hereby waived and the same shall be deemed to have been done with the assent of the Guarantor.
- 6) This Guarantee shall not be effected by any change in the constitution of the Guarantor or of the Seller nor shall the guarantee be effected by any change in the constitution of the Purchaser or any amalgamation or absorption with any other body corporated and this guarantee will be available to or enforceable by such body corporate.
- 7) This Guarantee is irrevocable except with the written consent of the Purchaser.
- 8) The neglect or forbearance of the Purchaser in enforcing any payment of moneys, the payment whereof is intended to be hereby secured or the giving of time by the Purchaser for the payment thereof, shall, in no way, release the Guarantor from its liability under this Deed.
- 9) The invocation of this guarantee shall be by a letter signed by the Purchaser
- 10) Notwithstanding anything stated herein before the liability of the Guarantor under this guarantee is restricted to Rs. /- (Rupees :) and interest as provided in Clause 1. This guarantee shall remain in force upto // unless a demand or claim under this guarantee is presented to the Guarantor in writing within Six Months from the date, all rights of the Purchaser under the guarantee shall be forfeited and the Guarantor shall be released and discharged from all liability hereunder.

IN WITNESS WHEREAS for any on behalf of the Guarantor has signed this Deed on the day and year above written.

for and on behalf of

B. PROFORMA FOR PERFORMANCE STATEMENT (For the last Five Years)

Bid No..... date of opening
 Time Hours

Name of the bidder

No. of years in service.....**

Order placed by (full address of purchaser)	Order No. and date	Incineration Boiler project capacity (TPH)	Value of order	Date of completion of delivery		Remarks indicating reasons for late delivery, if any	Has the Incineration boiler has been satisfactorily Functioning? (Attach a cert. From the Engineer in charge)
				As per Contract	Actual		
1	2	3	4	5	6	7	8

Signature and seal of the bidder

Note : **- Indicate the number of years in the line of business.

APPENDIX - I

BID FORM AND PRICE SCHEDULES

To
M/s -----

Gentlemen,

Having examined the Tender Document, including the Specifications, the receipt of which is hereby duly acknowledged, we, the undersigned, offer to engineer, design, manufacture, supply, deliver, install and commission the specified ----- on EPC basis in conformity with the said Tender Document, for the sum of (Sum of Total Bid Amounts for Goods and Services in Words and Figures), or such other sums as may be ascertained in accordance with the Price Schedules attached hereto and made part of this Bid.

We undertake, if our Bid is accepted, to commence delivery within (60) days, and to complete installation and commissioning of all the items specified in the Contract within (365) days, calculated from the date of receipt of your Notification of Award.

If our Bid is accepted, we will provide the performance security, equal to 10 percent of the Contract price, for the due performance of the Incineration boiler & auxiliaries with BoP and required bank guarantees for advances.

We agree to abide by this Bid for the period of 90 days from the date fixed for bid closing and it shall remain binding upon us and may be accepted at any time before the expiration of that period. Until a formal Contract is prepared and executed, this Bid, together with your written acceptance thereof in your Notification of Award, shall constitute a binding contract between us.

We understand that you are not bound to accept the lowest priced or any Bid that you may receive.

Dated this _____ day of _____ 2021

(Signature) _____

(In the Capacity of)

Duly Authorized to sign Bid for and on behalf of _____

(Signature of Witness)

Witness

Address

Note:

- All bids are to be only firm price bids.
- Purchaser may award separate contracts for supply and E&C
- Civil works, except cooling tower are excluded from scope. However, all structural steel, insert plates, pipe sleeves, foundation bolts, templates, fixtures, required to be embedded in RCC works, are in the bidders scope. All civil materials for cooling tower will be provided by purchaser.

Price Schedule

The bidder agrees to engineer, design, procure, manufacture, supply, erect and commission excluding civil works of the ----- on EPC basis as specified in and forming part of this tender document at a Total Price as mentioned below, exclusive of taxes & duties, hereinafter referred to as the “Contract Price”, subject to terms and conditions as hereinafter provided, as per the break-up given below:

A	Supply Ex-works (Ex-bidders or their sub-contractors workshop or place of supply) price in Lakhs, of :	
(1)	EPC of Incineration Boiler & Aux. with Balance of Plant (BoP) Project according to specifications and details given	NOT TO BE QUOTED HERE
(2)	Price of following necessary facilities in respect of above <ul style="list-style-type: none"> ➤ Final painting (it shall include primer and final painting as per colour scheme to be given by the Purchaser / Consultant).- ➤ Packing, forwarding charges ➤ Freight up to the site ➤ All consumable items such as welding electrodes, gases, emery papers, etc. required for erection purposes. ➤ All insurance charges applicable 	NOT TO BE QUOTED HERE
(3)	Spares as mentioned in Final Technical Offer	NOT TO BE QUOTED HERE
	Subtotal in Rs Lakh :	
	Sub total of A(1), (2) and (3)	
B.	Indicative Taxes & duties for Supply & Service: Custom duty @ ____ Excise duty @ ____ GST @ ____ Any other taxes & duties	Extra at actual
C.	Price for Erection & Commissioning	
	(Including all loading, unloading & handling at site), commissioning and trial run and supervision thereof including supply of all consumables, Rs. In Lakhs:	NOT TO BE QUOTED HERE
D.	Price for Deployment of OEM's/ Vendors technical manpower for supervision for another 2 years post commissioning to ensure guarantee run, Rs in Lakhs	NOT TO BE QUOTED HERE
E.	Price for Man day rates for deployment of Expert to the site to provide technical, operational and troubleshooting support to the Purchaser, post commissioning, for 2 years, Rs (The boarding and travel expenses shall be provided by the Purchaser)	NOT TO BE QUOTED HERE
F.	Indicative Taxes & duties for Erection & Commissioning and post commissioning Supervision: GST @ ____ Any other taxes & duties	Extra at actual

The above price is firm & final. There is no provision for escalation in the cost of this project, for which both the parties have agreed to between as per scope of supply described herein.

Supply, Erection and completion of the Job (Installation of Incineration Boiler and BOP) in all aspect as per satisfaction of the Purchaser/consultant including supply of all materials, consumables and labor and no extra cost will be borne by the client in any manner.

The total contract price offered above is exclusive of GST /Central / State VAT, Excise duty, Special Excise Duties, Custom Duties, works contract tax, local taxes and any other duties at the site only imposed by law, leviable on the plant and machinery supplied to the purchaser at total price offered and is also exclusive of single point Sales Tax, Excise Duties and special excise duties on finished bought items supplied directly to site from sub-contractors work. Bidder to quote with break-up of all applicable taxes & duties.

The increase or decrease in the amount of taxes and duties due to change in the rate / structure in the taxes and duties will be on Purchaser's Account, provided the material is supplied as per delivery / dispatch schedule.

Signature of Bidder with seal _____

Note :

- a. In case of Discrepancy between UNIT PRICE and total cost, the unit price shall prevail.
- b. Kindly mention unit price per meter also, for all piping and cabling.
- c. Bidder to give a statement of all taxes and duties and their rates applicable.
- d. Bidder to include description of goods being quoted, along with data sheet.
- e. Details of all the spare parts are required to be provided in the item master format (format will be shared by Purchaser to L1 bidder after award of PO) which will include all the technical details regarding the spare parts along with indicative price, approved suppliers with their details for ease in procurement after installation

APPENDIX - II

PAYMENT SCHEDULE

The PURCHASER shall pay the contract price in the following manner free of interest:

1. The payment terms will be as indicated below:

Total contract value will be divided as:

- **Total Supply value shall be maximum 80% of the total contract value**
- **Total E&C value shall be minimum 20% of the total contract value**
- **All Payments will be released only after 30 days from the date of certification of the bill by EIC & Consultant**

Supply:

- 5% of contract value for supply on signing of supply contract and submission & approval of design basis report and plant equipment layout
- 7.5% of contract value for supply on submission / approval of mutually agreed key drawings / information / documents/ civil load data (to be paid within 45 days of contract date) and against bank guarantee of requisite amount.
- 7.5% of contract value for supply on submission of copies of unpriced purchase orders for mutually agreed major bought out items / equipment (to be paid within 90 days of contract date) and against bank guarantee of requisite amount.
- 70% of contract value for supply against proforma invoice, payable pro-rata on receipt of material at site along with all test certificates, warranty documents & other relevant documents, if any , as per mutually agreed billing / delivery schedule (to be submitted within 30 days of signing of the contract), duly certified by Purchaser / Consultant
- 10% of contract value for supply on receipt of all material at site duly certified by Purchaser / Consultant and on submission of performance bank guarantee of requisite amount and valid for Two year, after successful commissioning of the plant.

Erection & Commissioning:

- 10% on signing of E&C contract and on mobilization and start of major erection work at site
- 80% of contract value for E&C pro-rata on completion of erection as per mutually agreed E&C schedule, duly approved by Purchaser / Consultant
- 10% of contract value for E&C on successful commissioning and performance proving and on submission of performance bank guarantee of requisite amount and valid for two crushing seasons after successful commissioning of the plant

2. All Payments shall be made in Indian rupee only. In case of imports, the terms of payments will be as per standard International practice
3. Prices charged by the SUPPLIER for goods under the contract shall not vary from the prices agreed by the SUPPLIER and given in the price schedule. This is the firm price contract for SUPPLY.
4. Taxes and duties, transportation, shall be reimbursable at actuals. Based on the production of documents by the SUPPLIER.
5. Defects liability Period: 12 months from the date of completion of the entire job. (To be read together with General terms & Conditions)
6. As per GTC, Original PBG for defect liability period (If vendor chose not to deduct 10% retention) to be submitted at Purchase dept, Patna and copy at site.
7. SECURITY DEPOSIT: Successful bidder has to submit security deposit of 1% of the Purchase Order Value in form of Demand Draft / Bank guarantee of any Scheduled (Other Than Cooperative Bank) Bank drawn in favor of HPCL Biofuels Ltd, Patna, and Payable at Patna.

Security deposit will be acceptable in the form of Demand draft upto Rs. 50,000/- and in the form of Demand draft / Bank guarantee beyond Rs. 50,000/-. Composite Performance Bank Guarantee (CPBG) valid upto a period of 3 months beyond the expiry of defect liability period. Demand Draft/ BG should be drawn on Scheduled Banks, other than co-operative bank.

In case of no defects observed, the Security deposit shall be refunded interest free within 3 months of the completion of the job.

8. RETENTION MONEY- Retention Money under Defect Liability Period should be 10% of PO value and will be released after one year from the date of commissioning & handover. Bidder may submit BG of equivalent amount or this 10% will be deducted from his bills against retention money

10% of the total value of the Running Account and Final Bill will be deducted and retained by the Owner as retention money on account of any damage/defect liability that may arise for the period covered under the defect liability period clause of the Contract free of interest. Any damage or defect that may arise or lie undiscovered at the time of issue of completion certificate connected in any way with the equipment or materials supplied by contractor or in workmanship shall be rectified or replaced by the contractor at his own expense failing which the Owner shall be entitled to rectify the said damage/defect from the retention money. Any excess of expenditure incurred by the Owner on account of damage or defect shall be payable by the Contractor. The decision of the Owner in this behalf shall not be liable to be questioned but shall be final and binding on the Contractor. Thus, deduction towards retention money is applicable only in case of job/works contracts (civil, mechanical, electrical, maintenance etc.) where any damage or defect may arise in future (i.e. within 12 months from the date of completion of job) or lie undiscovered at the time of issue of completion certificate.

APPENDIX - III
NO DEVIATION LETTER

(On Bidders Letter Head)

Ref No. :

Date :

**To,
The Chief Executive Officer
HPCL Biofuel Ltd
Patna, Bihar
800013**

Subject: Declaration of No Deviation for Technical & Commercial Bid Submission for EPC of Incineration Boiler & Aux. with BoP project, Sugali Site

Dear Sir,

We refer the bid document Volume - I (Commercial) & Volume-II (Technical) for above package, queries raised by us & clarifications received, discussion during pre-bid meeting held on -----

We hereby confirm that, there are no commercial & technical deviations in our bids & our bids shall comply with the Commercial (Volume I) & Technical (Volume II) bid documents, clarifications & MOM of Pre-bid meeting.

Regards,

(Authorized signature)

Regards,

(Authorized signature)

Signature and Seal of the Bidder

HBL/TEN/PUB/20-21/223 dated 06.02.2021

Page 79 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

APPENDIX IV

PENALTY FOR SHORTFALL IN PERFORMANCE

1. Incineration Boiler & Aux. with Balance of Plant

The following gives the penalties leviable for the shortfall in performance of the plant and equipment supplied.

Sr. No.	Nature of shortfall	Penalty applicable
1.	Failure to meet the guaranteed auxiliary Power consumption (for every kW increase or part thereof from the guaranteed parameter)	Rs.1,00,000
2.	Shortfall in capacity for every 1% reduction in steam Output	Rs. 1,00,000
3.	Failure to meet the guaranteed particulate emissions (for increase in every 5 mg/Nm ³ or part thereof from the guaranteed parameter)	Rs. 1,50,000

The following items are those guarantee parameters in which the shortfall in Performance is not acceptable more than the permissible tolerance indicated:

Sr. No.	Item	Unit	Tolerance
1	The steam generation capacity is lower than the guaranteed value, at rated parameters by more than	%	5.0
2	The total auxiliary power consumption of the continuously operated electrical equipment is higher than the guaranteed figure by more than	%	5.0
3	The Efficiency lower than the Guaranteed	%	2.0
4	Fuel handling capacity	%	4.0
5	Ash Handling capacity	%	4.0

SECTION II- TECHNICAL EPC BID FOR INCINERATION BOILER WITH BOP

CHAPTER – 1

DESIGN BASIS, SCOPE OF WORK AND TERMINAL POINTS

1.1 General

This EPC bid covers engineering, supply to commissioning of the incineration boiler along with all required and specified balance of cogen plant, civil inputs of all equipment within battery limit.

STG & its auxiliaries and civil designing & execution works are excluded.

The distillery cogen power plant will have installed capacity of 3 MW and will employ 44 kg/cm² and 400°C configuration. Slop (54 to 58% solids) generated by concentration of spent wash will be the principal fuel. All systems to be designed for slop quantity of 9.25 TPH. Boiler will be designed to accept Indian coal with GCV of 3800 kcal/kg and bagasse as support fuels. The requirement of support fuel to be about 25% of slop on heat value basis.

The auxiliary steam consumption for the cogen power plant will be for soot blowing and other auxiliary consumptions like SCAPH and for deaerator. The gross steam generation including the above auxiliary consumptions will be 22 TPH.

Proposed layout of the project is provided in *Appendix - I*.

The brief design parameters for the cogen power plant will be as follows:

Boiler capacity, TPH	:	1 x 22
Pressure, kg/cm ²		44
Temperature, °C		400
Turbine capacity, MW		3
Turbine type		Extraction cum condensing
Operation, days		300 to 330
Fuels used	:	Slop, bagasse / coal
Feed water temperature, °C	:	150

1.2 Ambient Conditions

As per, Project Information

1.3 Fuels

a) Design & Guarantee Fuels

The principal fuel will be slop with 54 to 58 % solids. This slop will be generated by concentration of spent wash in the distillery. Coal & bagasse will be used as support fuel.

The following will be the analysis and the Gross Calorific Value (GCV) Bagasse.

Ultimate Analysis	Bagasse
Carbon	23.50
Hydrogen	3.25
Oxygen	21.75
Moisture (AFB)	50.00
Ash	1.50
Sulphur (max 1.0)	0.00
Nitrogen	0.00
GCV (Kcal/kg) (AFB)	2272
Maximum bagasse moisture content	51 ± 2%

The following gives the Ash Analysis for Bagasse:

SiO ₂	:	50-60%
Al ₂ O ₃	:	10-13%
Fe ₂ O ₃	:	10-12%
CaO	:	3-5%
MgO	:	3-4%
TiO ₂	:	2-4%
P ₂ O ₅	:	1-2%
Na ₂ O	:	0.5-1.5%
K ₂ O	:	4.5-6.0%
SO ₃	:	Nil

Coal Analysis for design is given as below:

Fuel		Indian Coal
Carbon	%	39.9
Hydrogen	%	2.48
Oxygen	%	6.76
Nitrogen	%	0.67
Sulphur	%	0.38
H ₂ O	%	10
Mineral matter	%	39.81
GCV (from analysis)	Kcal/kg	3800

Estimated ultimate analysis of 55% concentrated spent wash:

Fuel		Slop
Carbon	%	20.4
Hydrogen	%	2
Oxygen	%	13.5
Nitrogen	%	1.45
Sulphur	%	0.56
H ₂ O	%	45
Mineral matter / ash	%	17.1
GCV (from analysis)	Kcal/kg	1750

1.4 Plant Design Criteria

The estimated cogen plant design criteria is as follows :

Sr. No.	Item	Value
	Operation	
1	No. of operating days, nos.	300 to 330
2	No. of hrs / day	24
3	Steam consumption, TPH	
	LP steam @ 5 kg/cm ² a	
	- Distillery	16 to 18.5
	- De-aerator	As required, design to be for nil condensate recovery. Normal operation to be for 55% condensate recovery from distillery process
	- SCAPH, as applicable	As per bidder's requirement
	Power generation, MW	Upto 3 MW
	Power consumption, MW	
	- Distillery process	About 1 MW
	- Cogen plant auxiliaries within scope	To be confirmed by bidder
	Boiler size & configuration	1 x 22 TPH, 44 kg/cm ² , 400°C (including internal steam requirements of deareator and SCAPH)
	Turbine size & configuration (supplied & erected by others)	1x 3 MW, extraction cum condensing

List of applicable codes & standards are provided in **Appendix - IV**.

1.5 Main Plant And Equipments

1.5.1 Steam Generator & Auxiliaries

The steam generating system for the Cogeneration plant will consist of one slop fired boiler with a Maximum Continuous Rating (MCR) of 22 TPH. The outlet steam parameters of the boiler shall be 44 kg/cm² and 400 deg C. The tolerance on the super-heater outlet temperature shall be a ± 10 Deg. C. The combustion system of the boiler shall be travelling grate with spreader stoker. The boiler efficiency, firing 100 % coal, shall be about 80 % on GCV basis. The flue gas temperature leaving the boiler to stack shall be chosen such that maximum economically possible efficiency is achieved but the temperature shall be sufficiently higher than the dew point considering the fuel characteristics. An ESP / bag filter is envisaged to control outlet emission to 50 mg/Nm³.

1.5.2 Turbo-generator & Auxiliaries

The same will be procured and installed by purchaser. However, all mechanical, electrical and C&I interconnections will be provided by bidder.

1.5.3 Fuel & Ash Handling

- 1 No main bagasse carrier to feed bagasse to boiler & feed excess bagasse to Return Bagasse Carrier.
- 1 No Return Bagasse Carrier to feed bagasse from yard to Main bagasse Carrier and to carry excess bagasse to yard.
- The drive assembly shall include the gearbox, coupling, common base frame, guards, electric motors, local push button stations etc.
- The technical parameters of above conveyors are tabulated below: Parameters like C/c distance, height are indicative only & shall be suitable for selected boiler dimensions

Sr. no	Description	MBC-1	RBC-2
1	Capacity TPH	4	4
2	Material	Bagasse	Bagasse
3	Bulk Density Kg/M ³	150	150
4	C/c Distance Mtr	15	50
5	Lift Mtr.	0	25
6	Angle of Inclination	0	45 deg. max
7	No of feed points	1	Through out the feeding length
8	No of discharge points	5 (To be decided by vendor)	1
9	Type of conveyor	Chain	Chain
10	Conveyor Width mm	800	800
11	Hood Cover	Required for Entire Length	

Coal handling system

Coal will be fed to coal hopper by pay loaders & conveyed to coal crusher through conveyor no CC-1. Crushed coal will be conveyed to Coal Bunker through Bucket Elevator BE-2 & drag chain conveyor DCC-3.

Over-band type magnetic separator mounted on conveyor no CC-1 to separate ferrous material from coal & only coal will be fed to crusher.

- 1 No grizzly hopper for coal of 3.0 MT capacity with 2000 x 2000 mm top opening & 150 X150 mm grizzly
- 1 No electro-magnetic type-vibrating feeder of 4 TPH capacity
- 1 No belt conveyor (CC-1) of 650 mm wide x 40 Mtr. C/C
- 1 No Over- band type magnetic separator suitable for 650 mm belt width
- 1 No crusher of 4 TPH capacity to crush ROM Coal to either (-) 20 mm or size as per boiler requirement
- 1 No bucket elevator BE-2 of 4 TPH capacity X 25 Mtr Height
- 1 no crusher house in M S construction
- 1 No Chain conveyor (DCC-3) of 650 mm wide x 21 Mtr. C/C

The technical parameters of above conveyors are tabulated below:

Sr. No	Description	CC-1	BE-2	DCC-3
1	Capacity in TPH*	4	4	4
2	Material	ROM Coal	Crushed Coal	
3	Bulk Density Kg/ cm ³	600	600	600
4	C/ c distance Mtr	40	25	21
5	Elevation at feed point M	(-)2.5	1	22
6	Elevation at discharge point M	5.0	26	20
7	Lift Mtrs (Indicative)	7.5	25	0
8	Type of Conveyor	Belt	Belt	Chain
9	Type of take up	Screw	Screw	Screw
10	Conveyor Width mm	650	500	500
11	Walkway	Required on both sides for conveyor no CC-1		
13	Hood Cover & side sealing	Required for conveyor no CC-1		

- Dust extraction system comprising of pulse jet bag filter, centrifugal fan along with Motor, ducting, hoods to ensure that the out let dust emission is below 50 mg/nm³ along with air compressor & piping in crusher house & coal bunker.
- System / distances indicated above are indicative only. Offered system should be capable to feed coal to slop fired boiler from yard as shown in the attached layout.

- Capacity mentioned is considering 12 Hrs of operation for 2.0 TPH requirement of coal for boiler. Bidder to confirm and offer as per coal requirement for their boiler, whichever is higher.

1.5.5 Ash handling system:

- Water jacketed screw Conveyors/ slat conveyors below each ash discharge points of 400 mm dia /500 mm width X suitable length as per boiler dimensions.. MOC of conveyors shall be min SS304 or to be suitable for ash temperature discharged through boiler
- Cross conveyors, slat type, 4 Nos. to convey ash, (2 each for ash discharge points below economizer and ESP and 2 for other ash discharge points) to 2 separate to ash silos.
- 1 number of Ash Silo of 50 M³ capacity with the supporting structure and sector type discharge gate of minimum 350 NB size.
- Bidders may quote for dense phase pneumatic conveying system for fly ash and submerged ash conveyor for bed ash. Required air compressor(1 operating + 1 stand by) with air receiver, compressed air piping, dense phase vessel with all instruments/valves, material piping, long radius bends, pulse jet bag filter for venting air and other required items for making the system complete are to be included.

The technical parameters of above conveyors are tabulated below:

Sr. No	Description	Screw Conveyors below ash generating point	Slat conveyor to collect ash from other ash hoppers to ash silo	Slat conveyor to collect ash from economizer and ESP hoppers to ash silo
1	Capacity TPH	4.0	4.0	4.0
3	C/C distance, m	As per boiler dimensions		
4	Lift, m	0	As required	As required
5	Angle of Inclination	0	30 ⁰	30 ⁰
6	Type of Conveyor	Screw/slat	Slat	Slat
7	MOC	Minimum SS304 or to be suitable for ash temperature discharged through boiler		
8	Width/ Diameter of the conveyor	400 /500 mm	500 mm	500 mm
9	One side Walkways	NA	Required for partial length	Required for partial length

1.5.6 Cooling Tower & Pumps

A closed circuit cooling water system to provide cooling water for power plant auxiliaries will be provided. Pumps and piping circuits will be provided for condenser & auxiliary cooling.

The cooling tower to be designed for continuous duty. The design of the tower shall be as per the enclosed specification.

The equipment offered shall be capable of cooling the rated capacity of water through the specified range at the design wet bulb temperature.

The specified design wet bulb temperature of 29⁰C includes the necessary recirculation allowance. Hence, Bidder shall design his cooling tower based on this design wet bulb temperature without considering further recirculation allowance.

While arriving at the air flow through the tower, due consideration shall be given to heat carried away by evaporation and enthalpy correction of altitudes.

The motor rating of the cooling tower fans shall be at least 110% of the fan power requirement at the motor output shaft to take care of any changes in tower loading or fan performance at a later date, Bidder shall furnish calculations for arriving at the motor rating.

1.5.7 **Water Treatment System**

DM water will be provided from the existing DM water storage tank. DM water will be tapped by the bidder from the delivery header of the DM water transfer pumps located at about 500 m from the incineration boiler and sized for 15m³/hr. Service water or raw water for cooling tower make up and other purposes will be tapped by the bidder from the existing WTP area at a distance of about 500 m. Service water pumps of 25m³/hr (1 W+1 S/B) with required head upto cooling tower basin and other application areas in scope.

1.5.8 **Compressed Air System**

Two (2) instrument air compressors will supply the requirement of compressed air for instruments and the control systems of the proposed cogeneration plant with one (1) working and the other standby. Each of the compressors shall be of 7 kg/cm² pressure. The air compressor shall be provided with accessories like Intercooler, after cooler, Moisture separators, Air driers, Air receivers and control panel.

The air compressor shall be oil free two (2) stage reciprocating non-lubricating type with belt drive. The design of the reciprocating compressor will be opposed piston dynamically balanced according to the standard.

The heat exchangers (inter and after coolers) shall be designed as per 'TEMA-C' and coolers shall be mounted horizontally. The cooling water flow shall be through tubes and the tubes shall be of copper. The internal surfaces of the cooler shall be galvanized. The coolers shall be fitted with moisture separators and all necessary accessories.

The air drier unit shall comprise of 2 x 100% absorber towers with one of the towers in operation and the other one in regeneration mode. The towers shall be fabricated from SA 515Gr. 70 or IS:2002 material and filled with alumina. The air drier shall be provided with sequence timer for automatic change over valves. The entire drying system shall be skid mounted.

The air receiver capacity shall be fabricated from SA 515 Gr. 70 or IS:2002 material. The internal surface shall be galvanized. The air receiver shall be fitted with all accessories including safety valves, moisture separators etc.

The control system of pressure switches, solenoid valves, regulators for automatic loading of compressors shall be mounted on a local control panel.

All air piping shall be galvanized.

The service air requirement of the Cogeneration plant, being very low will also be met by the instrument air compressors. However the service air will be directly tapped off from the air receiver by passing the dryer units.

The compressors are to be opposed, belt pulley driven, non-lubricating type reciprocating air compressors complete with drive guards, AC electric motors, LPBS, air receiver, intercooler, after cooler, moisture separators, air dryer, moisture traps, all interconnecting pipe work & fittings, control

panel, etc. The heat exchangers shall be designed as per TEMA-C and coolers shall be mounted horizontally. The air receiver shall be fabricated from SA 515 Gr. 70 or IS : 2002 material. The internal surface shall be galvanised.

Control air will be supplied to boiler and its auxiliaries, turbo generator and its auxiliaries and common plant auxiliaries like water treatment plant, fuel handling plant, ash, pump house etc. Compressed air will meet the requirements as stated below :

Capacity	: 150 m ³ /hr or higher as per plant needs
Nos.:	: 2 nos. (1 operating & 1 standby)
Pressure at receiver outlet	: 7 kg/cm ² (g)
Dew point temperature at Atmospheric conditions	: (-) 40 ⁰ C
Particulate material size (max.)	: 1 micron
Contaminants	: No corrosive, hazardous, toxic Or flammable material
Oil Content	: 100% Oil Free

It is proposed to interconnect the service air system with the instrument air system before the instrument air dryers. A non-return valve and a manual isolating valve will be provided in this line so that instrument air cannot be supplied to the service air system.

If any pneumatic systems for ash handling are proposed, they will have independent air compressors.

1.5.9 Tanks & Vessels

The tanks shall be designed, manufactured and tested in accordance with the requirements of the ASME – Boiler and Pressure vessel Code Section VIII. Other equivalent standards are also acceptable. Pressure vessels shall be designed as per IBR standards.

The cogeneration plant tanks will have storage capacities as required by design of the systems. Tanks will be of the closed top type. Low pressure tanks shall be designed as per IS 803 with minimum corrosion allowance of 1.5 mm.

Overflow connections and lines shall be provided where required and will be at least one pipe size larger than the largest input line or combination of inputs that can discharge simultaneously.

Maintenance drain connections shall be provided of an adequate size to facilitate drainage of tanks is within a reasonable time. Manholes where provided on tanks and pressure vessels shall be of size NB 500. The manhole covers shall be provided with davits. Ladders and cleanout doors will be provided on large tanks. All tanks shall be provided with interconnection platforms and staircase. The saddles and

reinforcement pads welded on to the vessels and tanks shall be of the same material as that of the vessel/tank shell or head. Insulated vessels shall be provided with insulation cleats for applying the insulation.

1.5.10 **Piping**

Piping will inter alia include:

- All integral piping of boiler & BOP.
- Main steam piping from MSSV to STG ESV (loose supply of fittings will be provided by STG supplier)
- All compressed air piping (GI or aluminium) for the entire scope and at one location in power house.
- All DM water piping (MSRL).
- Service water piping from existing WTP area to cooling tower basin and other applications in scope.
- Cooling water piping from cooling tower to the power house condenser and return. Distance of cooling tower from power house is about 40 m.
- Piping for transfer of slop from slop tank in bidders scope to boiler, with required heating.
- Piping for transfer of process condensate at outlet of transfer pumps in distillery to feed water tank / deareator near slop fired boiler in EPC scope.
- Process steam supply from extraction port of STG (loose supply of fittings by STG supplier) connected to process PRDSH near boiler upto existing distillery steam header with isolation valves on either side. Line to be sized for 20 TPH at 3.5 kg/cm²g.
- All vents to safe elevation and drains to be connected to nearest distillery drain channels.

All cogeneration plant piping will be as per applicable IBR / IS standards. All piping will be aesthetically and neatly laid on pipe racks with approved colour coding. The cogeneration plant piping will inter-alia include raw water intake, DM water, cooling water circulation, plant service water, compressed air ring, drain piping, steam piping from boiler to turbine including start up vent line at turbine end, steam piping from MSSV via PRDSH stations to STG, LP steam piping to all cogeneration auxiliaries, steam piping from PRDSH to process steam header, including desuperheater to maintain process steam temperature at 5 deg C above saturation. PCV to be before DSH and one pipe length after DSH to be of MOC of upstream pressure (44 ata)

Spray water piping for the PRDSH stations will be taken at appropriate intermediate pressures from the BFW pumps.

HP piping to be sized for highest safety valve pressure at 110% MCR with maximum pr. drop of 2 kg/cm² for the entire piping. The pipeline will be duly approved by IBR by the Bidder on the buyers behalf. Standard fittings like expansion loops, stream traps, supports etc. are to be provided. The line should be insulated to suit weather conditions and preferably of LRB mattress with multilayer mineral wool and aluminium cladding (22 g), to achieve skin temperature of not higher than 65°C. Stress analysis for the HP piping to be submitted by the Bidder along with IBR approved steam pipe drawing.

Start up vent piping upto atmosphere and valves for the same to be as per boiler working pressure and as per IBR.

The main steam line drains and the steam vent line before ESV to be sized to achieve cold start up in a reasonable period of about 20 minutes without any undue pipe stresses. All drain lines on main steam piping to be minimum 50 NB.

Required steam blow off line and arrangement near steam turbine to be provided by bidder. Required atmospheric blow off line in exhaust piping along with valves to be provided. All blow off or vent lines to be provided with silencers.

All piping required for effectively connecting the steam generator with the steam, feed water, and other systems shall be provided. The piping provided shall be complete in all respects including valves, fittings, supports etc. as required. Necessary supporting materials, towers and trestles to support and anchor the pipelines at regular intervals shall be supplied. Suitable expansion loops and hangers shall be provided wherever necessary.

Suitable expansion loops restraints and anchors shall be provided so as to ensure compliance with the applicable codes and to limit the stress and reactions to within the allowable values.

‘Y’ type strainer to be provided on suction of all pumps, except where basket / conical strainers are provided.

- a. The flow velocities in pipes shall be limited to the following values:

Nominal pipe size In mm	Average velocity in Meter / Second		
	Below 50 mm	50 to 150 mm	200 mm & above
Saturated steam at sub-atmospheric pressure	-	10 – 15	15 – 20
Saturated steam at 0-1 kg/sq.cm.(g)	15 - 20	17 – 30	20 – 30
Saturated steam at 1.1 - 7 kg/sq.cm.(g)	15 - 22	20 – 33	25 – 43
Saturated steam over 7 kg/sq.cm.(g)	15 - 25	20 – 35	30 – 50
Superheated steam at 0 - 7 kg/sq.cm.(g)	20 - 30	25 – 40	30 – 50
Superheated steam at 7.1 – 35 kg/sq.cm.(g)	20 - 33	28 – 43	35 – 55
Superheated steam at 35.1 – 70 kg/sq.cm.(g)	22 - 33	30 – 50	40 – 61
Superheated steam over 70 kg/sq.cm.(g)	22 - 35	35 – 61	50 – 76
Compressed air	7 – 10	10 – 15	18
Pump suction, condensate	-	0.4 – 0.6	0.6 – 0.7
Pump suction, boiler feed	-	0.6 – 0.9	0.6 – 0.9
Pump suction, general service	0.6 - 0.9	0.7 – 1.3	0.9 – 1.5
Pump suction, viscous liquid	0.3	0.3 – 0.4	0.4 – 0.5

Pump discharge, condensate	0.9 - 1.2	1.2 – 2.1	1.5 – 2.2
Pump discharge, boiler feed	1.0 - 1.2	1.5 - 2.1	1.8 – 2.4
Pump discharge, general service	0.9 - 1.0	1.5 - 2.4	1.5 - 2.4
Pump discharge, viscous liquid	1.0	1.0	1.2 - 1.4
Header, general service under 2.0 kg/sq.cm.(g)	-	1.3 - 2.0	1.8 - 2.4
Header, general service 2.0 kg/sq.cm.(g) & up	-	1.5 - 2.4	2.1 - 2.4

- b. Drains at all low points and vents at all high point shall be provided.
- c. All local instruments shall be located on pipelines so as to render them observable from the nearest available platform.
- d. Oil drains shall be sized to run no more than half full when flowing at a velocity of 0.3 m / sec, and shall be arranged to ensure good drainage.

1.5.11 **Insulation**

High grade insulation materials suitable for outdoor Steam generators shall be supplied with LRB mattress with mineral wool of multilayer with aluminium cladding, water proof lagging and protected from rain water, wind and Dust etc. for the exposed portion of the steam and mud drums, steam generator furnaces, integral pipe work from the feed pumps to the steam generators, steam & exhaust piping, hot air & gas ducting, condensates pipes, valves having high temperature fluids & hot water / condensates feed water tank, de-aerated water tanks, and other steam generator accessories to be provided.

Glass wool materials is used should confirm to I.S. 3690 - 1974 type 2 mineral wool shall confirm to I.S. 5696 - 1970. The thickness should be to suit the diameter and temperature of pipes. The wire mesh should be of galvanized wire and lugs/pins used should be galvanized.

1.5.12 Electrical System

LT power will be supplied at 3 incomers of MCC's in bidders scope. Entire onward distribution of power including above ground earthing of equipment in bidders scope will be done by the bidder.

VFD's will be provided for boiler feed water pumps, boiler slop feed pumps, all boiler fans, coal feeders, and cooling tower circulation pumps.

A) Design Considerations

A) Site data

- a. Ambient temperature : 50° C
- b. Humidity : 90%
- c. Altitude : <1000 M above MSL.
- d. System Fault Level : 40 kA for 3 Sec. for 11kV system
: 50 kA for 1 Sec. for 415V System
: 9 kA for 1 Sec. for Lighting Circuits

B) POWER SUPPLY:

- a. 415 V + 10% , 50Hz + 5 % , TPN for plant Aux. load operating at 415V supply
- b. Control Voltage 110V AC, 50Hz for MCCs and PCCs
- c. Power Supply for Space Heaters, Plug Sockets, Lighting : 230 V, 50 Hz, 1Ph.
- d. Power Supply for Tripping and Closing Circuits of Circuit breakers : 110 V, D.C.
 - a) 230 V Single phase power supply shall be derived through Phase & Neutral for single phase power consumer.

C) DESIGN CRITERIA IN EQUIPMENTS / POWER DISTRIBUTION :

- All Bus bars shall be Air insulated and of ALUMINIUM. Bus bar size shall be selected based on Temperature limit of 85 °C at Bus bar for the rated current. Max. Current density of bus bar shall not be more than 0.7 A /sq. mm. for PCC & 0.8 for all other panels. All bus bars shall be provided with heat shrinkable sleeves of Full Voltage rating. 11KV Bus bars shall have sleeves rated for 12KV grade with insulation shrouds at joints.
- Power Cables (HV & LV) shall be XLPE armored. ALUMINIUM conductors above and including 6 sq. mm. size. Power cables including and less than 4 sq. mm. shall be copper conductor. All cables shall have stranded conductor construction only.

PCC shall have EDO ACBs for all Incoming feeders. All outgoing feeders having 800A & above rating shall be MDO ACBs. All ACBs & MCCBs shall have microprocessor based

releases with Earth Fault protection. Feeders up to 630A rating shall be with fixed type MCCB.

- Length of MCC shall be limited to 10M.
- Maximum operating load on MCC shall be limited to 500KW. In case the operating load is more than 500KW, separate MCC shall be considered.
- Squirrel Cage Motors up to & including 22 KW shall have automatic DOL Starter suitable for operating from MCC, DCS and PB Station near Motors. Selector Switch shall be provided in MCC for this purpose.
- Motor rating above & including 26 KW up to 160 KW shall be with Automatic Star Delta -Starter suitable for operating from MCC, DCS and PB Station near Motors. The Starting requirements shall be verified with motor manufacturers for star Delta Starting by super imposing Torque Speed Curves of driven equipment.
- Motor rating above 200KW shall be operated with Soft Starter suitable for operating from starter, DCS and PB Station near Motors. Starter shall have bypass contactor with AC3 rating.
- In PCC and MCC there shall be min. One spare feeder for each rating.
- VFD shall be provided as per the functional requirement. In VFDs input choke & other devices shall be provided to achieve current and voltage harmonics (THD) within IEC permissible limits.
- MCC shall be floor mounted self supporting, dust and vermin proof, fixed type construction.
- Motor Control Center (MCC) shall have MPCB & Contactor for starters up to 22KW & MCCB, Contactors, Star Delta timers & Electronic O/L Relays above & including 26KW rating. Starters on MCCs shall have 'ON' & 'TRIP' indication. The selection of switchgear components shall be minimum with one size higher than Type II co ordination as per IS 13947.
- Motor protection shall be provided in ACVF Drives & Soft Starters, as inbuilt protection functions.
- Rating of Switchboard incomer ACB/SDF shall be 1.2 times the operating load current.
- Push Button Station with Shrouded type actuator for ON push button, Lockable Mushroom type actuator for OFF Push button with Aluminum die cast enclosure shall be provided. Push Button Station for Motors above 22KW rating shall be provided with suppressed scale Ammeter. Push Button Station for VFD shall have Speed Setting Potentiometer and speed indicator in addition to Push Buttons and Ammeter.

D) POWER FACTOR IMPROVEMENT

1. Plant PF shall be required to improve above 0.98

2. This is achieved by providing :
APP Capacitor Banks at MCCs and Provide Automatic Power Correction Panel with required no. of APP type capacitor banks in 415V PCC. Fixed type capacitors shall be connected near MCC with appropriate capacitor duty contactor and FSU feeder in MCC.
3. To determine number of capacitors following consideration be given. Operating KW & Average operating P.F. Drive with VFD shall maintain P.F. above 0.95. These loads shall not to be considered for deciding capacitor rating.

E) LV POWER CONTROL CENTRE (PCC)

The following points shall be considered while designing and selection of components.

I) TYPE OF FEEDERS:

Incomers	: D.O. – 4 Pole EDO ACB
Emergency Power Supply Feeder / Tie Feeder	: D.O. – 4 Pole EDO ACB
Outgoing Feeders	: MDO Type ACB above 800A rating & fixed type MCCB up to 630A rating.

II) BUSBARS

Color Coded Sleeved Aluminum Bus bar Size shall be selected as per following norms:
Continuous current carrying capacity as per the Rated Current of Incomer
Temperature Rise Limit
Short Circuit Withstand Capacity
Max. Current Density requirement

F) MOTOR CONTROL CENTRE (MCC) :

The following points shall be considered while designing & selecting components.

- I) Incomer Feeder - MDO ACB above 800 A Fixed type MCCB up to 630 A
- II) Outgoing Starter Feeder Feeders shall be comprising of:
MPCB / MCCB

Contactors

Electronic Overload Relay for rating of 26KW & above

Timer in case of Star Delta Starters

Push Button

Indicating Lamps

III) Bus bar

Above 125A rating

IV) Control Logic

01) Plant shall be capable of operation from MCC, DCS located at Central Control Room or locally from Push Button Station near motor.

02) It will be possible to start the Motor locally through enable command from DCS.

03) All electrical parameter of Incomer shall be communicated to DCS through 485 port in MFM.

04) ON/ OFF and Trip Status of the Motor shall be communicated to DCS

V) Provision of Spare feeders

1 No. of each rating spare feeder shall be provided in MCC

G) LV BUS DUCTING

Bus duct shall be with CRCA enclosure with color coded sleeved Aluminum bus bar. Short circuit rating shall be 50KA, 1 sec.

H) GROUNDING / EARTHING SYSTEM) & LIGHTENING PROTECTION

01) Earthing shall be done according to IS 3043 – 1987.

02) Earthing shall be carried out by G.I. Strips & Wires. Earth Electrodes shall be 100 mm, 10 thk. C.I. Pipe type. Trafo. Neutral will be connected to G. I. Earth Electrode through Copper Strip.

03) Total Resistance of Earthing system shall be less than one ohm.

04) Plant shall be protected against lightning according to IS 2309-1989. Horizontal air termination and down comers shall be considered as per the requirement.

I) CABLES

The following consideration shall be given for Cable Sizing and Selection on Nominal Current Capacity

Ambient Temperature in Air/Ground

Continuous Load Current

Short Circuit Withstand Capacity

Voltage Drop at the Starting of Motor limited to 12% & 3% at Starting & Steady state up to motor terminals respectively. For Lighting & Power Distribution circuits the voltage drop shall be limited to 2%.

Deration Factor due to type of Laying & Grouping.

Generally Power and Control cables shall be stranded.

XLPE insulated cables up to & including 4 sq.mm shall be with stranded copper conductors. Cables of 6 sq.mm & above size shall be with stranded Al. conductor

J) CABLE TRAYS, ACCESSORIES AND SUPPORT

01) Cable trays shall be prefabricated Hot Dip Galvanized Iron

02) Cable Trays shall be run in Vertical formation as far as possible.

03) HV & LV Power Cables shall have separating distance of 300mm min.

04) Separating distance between Power and Control cable shall be 300mm.

05) Instrument cables & screened shall run on perforated cable tray having 300 mm separating distance of 300 mm.

06) GI Cable trays shall be fabricated from 2mm thick CRCA sheet steel. Perforated trays shall be used up to 300 mm. size. Above 300mm, ladder type trays shall be used.

K) ILLUMINATION SYSTEM :

01) The Lux Level in various indoor areas shall be as per IS. In plant areas, the lighting shall be provided as per functional requirement.

02) LED type Well Glass with integral control gear box fittings (IP55) shall be Provided in plant areas. Industrial LED Batten fittings will be provided in sub station and other indoor areas. Mirror Optic LED fixtures shall be provided in CCR. In

outdoor areas LED Lamp fixtures (IP 55) shall be provided.

- 03) The lighting shall be catered by Main Lighting DB. LDB & SLDB connected by Al. conductor cables. The Emergency power supply from 415V DG set will be made available to lighting transformer in case of failure of power

L) HV & LV MOTORS

Motors shall be as per IS 325. LV motors shall be IP 55 degree of protection

Motors shall have insulation of class F and temperature rise limit of class B. Motors shall be designed with 50 °C ambient .

Motors above 30 KW shall have space heaters.

Motors above 90 KW shall have 6 Nos. RTDs for winding temp

Motors rating have 15% margin over the load requirement.

Motor data sheet is provided in *Appendix - VI*.

1.5.13 **Fire Fighting System**

Fire fighting scheme meeting TAC recommendations and ensuring plant & personal safety will be constructed.

Pressurized fire hydrant system will consist of a pipe network and hydrants positioned around the station in sufficient numbers and so located that all buildings and risks are readily protected. Necessary number of loops will be formed around various risks. Major areas to be covered are incineration boiler, ESP, power house and fuel storage. Fire hydrants with spray nozzles to be provided at appropriate distance of about 25 m to cover these areas.

The loops will be interconnected for better reliability of the system. To isolate a portion of the ring main because of damage/repair, suitable nos. of valves will be provided.

The hydrant network will be sized and analysed to ensure that about 3.5 kg/cm² pressure is available at the hydraulically remotest point in the system with the existing hydrant pumps. Head of existing pumps is 70 m. The velocity in the hydrant main will not exceed 2 m/sec.

The fire alarm system shall consist of smoke detectors, heat detectors, fire alarm panel, hooter, manual call point etc. The detectors shall be located in all the electrical panel rooms, control room and battery room. The manual call point and hooters shall be located throughout the entire TG building. The detectors will sense the fire automatically and will generate fire alarm through Fire alarm panel.

The portable fire extinguishers shall consists of dry chemical powder type, carbon-di-oxide type, foam type fire extinguishers. The extinguishers shall be located strategically inside the TG building, electrical rooms and near generator transformer.

For fuel handling system, spray nozzles will be provided on top of the conveyors or on the canopy at 2 m spacing and will be provided fire water through a distributor pipe with required deluge valves. All pipes will be GI of heavy grade. Heat detectors will be provided at 25 m spacing. The same system will be provided, excluding heat detectors for the fuel storage yard. The coal covered storage yard will be about 2500 sq.m and bagasse storage yard will be 1000 sq.m.

Passive type fire fighting to be provided as per norms for the generator transformer including fire extinguishers and sand buckets.

HVWS system to be provided for STG lube and control oil tanks, coolers, pumps area. Quartzoid bulb detectors to be provided for fire water sprinkling to cover the entire area. Required HVWS projectors to be provided in the spray pipes. Hydraulically operated deluge valves to be provided.

1.5.14 **Instrumentation & Control System**

The entire plant will be controlled by a centralized DCS with high redundancy level with inputs and controls of all loops, analyzers, control valves, motorized valves, motors, etc.

The integration of all the inputs / signals for continuous monitoring, operation, data logging, data analysis, alarms, safety interlocks, annunciations etc. will be achieved through the DCS. Schematic configuration of DCS is shown in **Appendix – II**.

The DCS will include the DCS control station, related licensed software & hardware, instrument & control cabling from the marshalling cabinet receiving signals from junction boxes of all cogeneration equipment, all MCC's and software links with Turbo-visory panel, Woodward Governor and turbine temperature scanner.

Bidder shall supply Turbine Supervisory panel comprising of Woodard 505 E governor, Vibration Monitoring System (2 nos. radial vibration at each bearing of turbine, generator & gearbox, one axial probe) and Electronic Overspeed. Trip device (with 2 out of 3 voting). A 16 Channel temperature scanner shall be provided for TG bearing RTD's.

Generator shall be suitable to run in parallel with grid and existing sugar cogen turbine. Turbine auxiliaries shall be controlled from DCS.

The entire cogeneration plant will be smoothly started, normally operated, provided with necessary interlocks & emergency trips, monitored, controlled and smooth shut down from the DCS. The DCS to have required software or compatibility to internet.

Basic Control Design should be as below:

- Generator, gearbox, turbine bearing temperature monitoring shall be through the temperature scanner.
- Redundancy at IO level is not envisaged. All controllers for critical controls will be redundant. The field inputs for critical inputs will be 1/2 logics.
- SOE of integral type to be provided.
- Required Annunciation windows shall be included

- 25% spare I/O's to be considered.
- TG governing will be by Woodward 505 E. However the critical parameters will be monitored by providing serial Modus Interface
- All I/O's will be potential free

1.6 SCOPE OF WORK

The Bidder is responsible for the entire scope of the cogeneration project between the given terminal points. This document elaborates on the specific requirements of this project and need not be considered comprehensive. All plant & equipment, services required to commission the cogeneration project are deemed in the scope of the Bidder. All services, plant & equipment will be as per relevant IS / ASME / IBR or other applicable standards. Partial list of applicable standards are given in this document. In case of conflict between given standards and alternate applicable standard, the more stringent will prevail. In case of absence of detailed standard for particular service / equipment, the Bidder will follow good engineering practices as approved by the Purchaser / Consultant.

The scope of work inter-alia will include:

- Detailed engineering and design including submission of the same for all mechanical, electrical and I&C requirements of this cogeneration project.
- All required load and foundation data for the required footings, foundations, columns, buildings, trenches, cable galleries, fencing, drains etc. All required templates, insert plates, shims, foundation bolts etc. will be provided by the bidder.
- Steam generator / incineration boiler & auxiliaries
- Slop, fuel & ash handling
- Cooling tower & cooling water circulation.
- Electrical distribution for the entire scope.
- Electrostatic precipitator or bag house to meet ODC of 50 mg/nm³.
- DCS
- All required cabling, piping and earthing within the terminal points.
- All required utilities to operate the cogeneration plant including UPS power, DC power, compressed air, lighting, etc. Yard lighting in fuel handling area and plant road / access area to be provided.
- All detailed piping along with required pipe racks, structures, insulation, supports, drains, traps, valves, fittings, instrumentation etc.
- Obtaining all required statutory approvals for construction of cogeneration plant including IBR approvals, labour commissioner, excise, factory inspector as applicable, registration & payment of all taxes & duties for bidders' staff & labour, as per all applicable laws, etc. Statutory fees, if any, will be paid by the Purchaser and applications required, if any will be made by the Purchaser.

1.7

TERMINAL POINTS

Utility	Terminal Point
Raw water	From existing WTP area at a distance of about 500 including new pumps of suitable capacity and piping
DM Water	At delivery header of existing DM water transfer pumps at a distance of about 500 m.
Effluent	All drains or effluent generated will be connected to the proposed plant drain channels.
Ash	At bottom of ash silo gate at 2 m elevation from FFL
Coal & Bagasse	At feeding points in fuel yard
Slop	At the slop receiving tank (80 m ³) with agitator, in EPC scope
Power distribution	LT power will be supplied by purchaser at 3 incomers. All onward distribution in bidders scope.
Earthing	Entirely in Bidder's scope within terminal points, earth pits will be provided by purchaser.
Illumination System	Entire illumination of cogen plant and associated area.
Power Distribution including Panels, Cabling, cable trays & Accessories	Entirely in Bidder's scope within terminal points. All cabling to be above ground on cable trays.
Instrumentation & Control	Entirely in Bidder's scope within terminal points including DCS, cabling up to marshalling cabinet in Electrical PCC panel
Lighting and Plant Utility supplies	Entirely in Bidder's scope within terminal points including boiler & F&AH system. Outdoor lighting along the building periphery is in bidders scope.
Flue Gas	At inlet of RCC chimney, chimney in others scope.
Steam supply	At header in distillery (distance of about 200 m). Extraction steam piping to distillery to be designed for 20 TPH.
Main steam	At inlet of STG ESV
Condensate	At outlet header of condensate transfer pumps in distillery at a distance of about 150 m.
Condensate from STG condenser	At outlet flange of CEP control station to deareator
Compressed air (Instrument & Service)	Entirely in Bidder's scope within terminal points
Cooling water piping	From cooling tower pumps to condenser and turbine auxiliary CW headers and return, to all other equipment including BFW pumps in bidders scope (C.W. Pumps, piping and C.W. headers is in bidder's scope)

Utility	Terminal Point
Civil Works	All required load data, layouts and civil inputs of all plant & equipment within battery limit for designing & execution of civil work by Client .
Vents	To safe elevation. All steam vents from blow off lines, first safety valve, start up vent, deareator vent to have silencers.
Drains and Overflow	To nearest drain or trench at FFL.

TECHNICAL SPECIFICATIONS FOR MECHANICAL & ELECTRICAL EQUIPMENTS, INSTRUMENTATION & CONTROL AND ERECTION & COMMISSIONING**2.1 Steam Generator & Auxiliaries**

2.1.1 Steam generators will be designed, manufactured and approved as per Indian Boiler Regulation Act, 1950 & its latest amendments.

The steam generators will be complete including all items as per the list given below:

- Slop firing system including receiving tank, 80 m³, SS304 with agitator and delivery pumps from receiving tank to boiler. Any required preheating to be included in bidders scope. Preheating, if any will be by the exhaust steam and condensate will be returned by bidder to condensate transfer tank. Slop will be transferred to boiler by choke-less screw pumps with VFD drives. Steam tracing to be provided for the slop line to maintain viscosity.
- Coal feeding system with coal bunker for 12 hours storage.
- All pressure parts (drums, water walls, headers, etc.). All pressure part tubes to be seamless and indigenous.
- Refractory
- Travelling grate system
- Ash hoppers with RAV (except furnace)
- ID, FD, SA fans and VFD for all fans.
- Ducting
- Structurals from RCC footings, ladders, platforms, supports and foundation bolts & required templates for the same, insert plates.
- All internal piping with insulation & cladding for steam, pegging steam, cooling water, feed water, service & instrument air, economiser and air preheater, etc.
- Instrumentation and control suitable for total operation through DCS.
- Dampers, soot blowers and associated controls / piping.
- Deaerator & DA storage tank.
- 2 x 100% BFW pumps with LT motors & VFD
- Economiser on separate axis.
- ESP along with required TR sets, panels, I&C, structure, expansion bellows, RAVs with all protection & safety devices or bag filter with required structures and spares.
- Attemperator system of direct spray type.
- LP and HP dosing system.
- CBD & IBD with steel tanks. CBD & IBD valves to be at FFL. Isolating valves to be provided at drums.
- Boiler feed water piping
- HP steam piping and fittings upto power house including PRDSH stations.

- Valves including specified motorised valves and fittings. relief valve with silencer, isolation valve and exhaust piping.
- Silencers to be provided for first safety valve, air vent valve, extraction steam line vent, deaerator vent, all continuously operating steam vents and FD suction.
- Electrical cabling, MCC, switchgear and controls
- Vents upto safe elevation
- Electrical and instrumentation control panels.
- All other auxiliaries and steam generator components required for safe, reliable and continuous year around steam generation.
- Pegging steam line from steam generator to deaerator for start up.
- All power & control cabling, instrumentation, cable trays, supports etc.
- Any other item not listed but essential to complete the steam generation system

2.2 Steam Generator Technical Parameters

- No. of water tube type steam: One generators (No.)
- Maximum Continuous Rating (kg/hr) 22,000
- Peak Generation 110% of M.C.R for half an hour / shift
- Steam pressure at boiler MSSV 44 kg/ cm²
- Steam temp. at boiler MSSV 400°C ±10⁰C
- Feed water temperature to economiser 135⁰C-150⁰C
- Deaerator outlet temperature 135 ⁰C -150⁰C
- Excess air % of Theoretical air required As per bidder's design (13.5 to 16% oxygen in slop to be considered for fan sizing)
- Fuel Normal Slop with 55% solids (range of 54 to 58%) with support fuel (coal of 3800 kcal/kg or bagasse)

- Note: a) Steam generator to be designed for continuous operation through the year with normal steam generation of 22,000 kg/hr.
- b) Steam generator to be with all steel columns from RCC footings with minimum civil works.
- c) Purchaser will provide only RCC footings and entire boiler will be on own steel structure.

2.3 Steam Drums

The steam generators shall be provided with one steam drum and one mud drum, if applicable and the drums shall be of fusion welded type. Both the drums shall be provided with Torispherical / Semi-Ellipsoidal dished ends fitted with oblong man ways at either end. The man way doors shall be hinged and arranged to open inwards. The drum shell, dished ends and the man way doors shall conform to IBR. The steam drums shall be liberally sized to assure low steam space loading, with adequate space to accommodate the internals.

The steam drum shall be provided with internals of proven design, shall be bolted type, and of size that will enable removal through the man ways. The system of internals consisting of the primary and secondary separators shall ensure steam of highest purity with dissolved silica carry over limited to a maximum of 0.02 ppm. The steam drum of the Steam generator to be provided with suitable internal fittings comprising of cyclones, primary and secondary scrubbers to ensure steam of highest purity.

The necessary nozzle connections for the following, but not limited, steam outlets, safety valves, feed water inlets, continuous blow down, level indicators, remote level indicator at operating floor, chemical feeding, vents and drains, sampling connections, down comers shall be provided on the drums as applicable. All nozzle connections on the drums shall be of welded type and the feed water inlet shall be provided with a suitably designed thermal sleeve.

The necessary drum suspension / support arrangements shall be provided.

The steam drum of the steam generators to be provided with suitable internals to promote circulation and to ensure high purity of steam. The final drum internals shall be of stainless steel and bolted (dismantling) Construction to facilitate cleaning of the internal surface of steam generator bank tubes and furnace tubes etc.

The water distribution system in the steam drum will be through a distribution header below low water level, to facilitate equal distribution through the drum.

2.4 Steam Generator Tubes

2.4.1 Furnace Water Wall Tubes

Furnace will be designed as two pass. Sufficient height and volume will be provided to ensure combustion of slop in the furnace. The FEGT in all operating conditions should not exceed 700 Deg C. Rate of support fuel firing to be controlled through DCS based on target FEGT or furnace temperature to be maintained. Pitch to be chosen to ensure minimum fouling.

The Furnace envelope shall be constructed of fully water cooled membrane / Fin welded walls and adequately supported. The design shall be such as to prevent distortion of steel work due to thermal expansion. The construction shall be fully gas pressure tight, and the furnace shall be strengthened by providing buck-stay and tie-bar system.

Necessary provisions shall be made in the furnace for admitting the required quantity of over fire air at various levels. SA fan nozzles to be provided above the slop firing nozzles. Highest possible turbulent furnace to be maintained for highest combustion efficiency and low support fuel.

The furnace EPRS should be so selected to give acceptable furnace outlet temperatures. The furnace design shall incorporate necessary manholes, peep holes, openings for the fuel distributors, ignition / reflection arch and refractory covering in the lower furnace area if required.

Adequate number of inlet and outlet headers, with the necessary stubs, commensurate with the arrangement of the furnace shall be provided. Each of the headers shall have at least two numbers of stubs for inspection and cleaning. The down-comers, supply pipes and raisers sizing shall be based on the circulation calculations. The arrangement will be of water cooled membrane wall construction.

2.5 Steam Generator Headers

All headers in the steam generator shall have flat end covers, and a minimum of one stub at each end for the purpose of cleaning and inspection.

No header shall be placed in the flue gas path.

2.6 Evaporator Bank

The evaporator bank will be external to the furnace and will be provided after the external super heater. Transverse pitch of 150 mm to be provided. Evaporator design to be vertical.

The bank tubes shall be expanded into both the top and the bottom drums, and the tubes after expansion shall be bell mouthed. There shall be adequate approach space to the tubes of the bank maintenance. Baffles if required shall be of simple design with material suitable for with standing the gas temperature.

Adequate number of soot blowers shall be provided to cover the maximum surface area of the bank.

No butt joints shall be permitted in the bank tubes. The Steam generator bank side walls shall be fin welded, or shall be of such construction totally eliminating air ingress or gas leakage and with suitable openings for the man ways, inspection peep-holes and soot blowers.

Steam generator headers to be constructed in accordance with the IBR/ISO specifications. The headers shall be provided with end plates with extended stubs. The extended stubs will be cut for inspection & cleaning and will be re-welded.

The tube spacing will enable easy removal of the tubes in case of any failure.

The evaporator bank to be provided with ash hopper with refractory. Minimum size of RAV to be 400 mm.

To avoid erosion from incoming flue gas, the evaporator bank will be provided suitable cascade baffles or / and sacrificial empty coils or / and SS cladding on first array of coils.

Pre-ash collector zone to be provided after evaporator section.

2.7 Super Heaters & Superheated Steam Header

The steam generator shall be provided with external super heater placed after the furnace of adequate heating surface capable of superheating the steam generated by the steam generator to the final steam temperature required at isolation valve of turbine and complete with headers, its mountings and fittings including safety valves, motorised isolation valves, start-up vent valves, flow nozzles, drain valves, air vent valves and pressure and temperature gauges etc., as per I.B.R. Temperature at super heater outlet will remain steady at design value from 60 to 100% MCR.

The tube elements of superheater and header to be as per IBR 1950 and its latest amendments.

The SH inlet header, shall be connected to the steam drum by means of suitable number size of tubes which will be of carbon steel. The secondary superheater manifold shall be fabricated from solid drawn seamless alloy steel pipes and as per IBR regulations.

The superheated steam manifold is to be equipped and complete with branches for main steam take off, safety valve, air release valve, drains, temperature and pressure gauges and other connection etc.

Additional thermo wells in the outlet manifold shall be provided to measure the temperature of superheated steam.

The super heater design shall be such that the temperature of steam at super heater outlet shall not exceed the design value in any case.

Necessary attemperator to be provided at super heater outlet to maintain the design temperature.

The design shall make provision for the future installation of thermocouples for the measurement of the metal temperature of a few of the hottest tubes (based on the metal temperature calculations) across the width of the steam generator outside the gas path. The tube spacing of the superheater shall be designed to minimize bridging and tube erosion and shall be suitable for proper on-line cleaning by means of installed soot blowers or tumbling hammers. Suitable spacers shall be provided both along and transverse to the gas flow directions.

The SH system shall be complete with required seamless pipe headers, inter connecting piping, vents, drains, supports, tube spacers, valves, fittings, etc. The superheater header material shall be selected based on IBR code. The superheater tubes shall be designed with adequate flexibility against thermal expansion differentials. The outlet header shall be suitably supported and anchored such that the piping forces and moments incident to the steam piping will not cause excessive stresses in the element tubes.

The external super heater will be provided with ash hoppers with refractory. The hoppers will have RAV of minimum 400 mm.

To avoid erosion from incoming flue gas, the super heater will be provided suitable cascade baffles or / and sacrificial empty coils or / and SS cladding on first array of coils.

(a) Attemperator System

Attemperator shall be to control the final steam temperature at 400 +/- 5°C between 60% to 100% MCR load.

The atomizer system will be of spray type. The spray water will be obtained from the boiler feed pump header.

1 x 100% pneumatic spray control valve with manual inlet and outlet isolation valve is to be considered.

2.8 Furnace

The furnace design will be typical to an incinerator. Furnace will be two pass or more with required volume and height to enable high residence time till flue gas reaches super heater. Slop will be fired through nozzles at appropriate elevation to permit water evaporation and effective combustion. SA nozzles will be located above the slop nozzles to prevent any carryover. The tube pitch will be generous to minimise fouling.

The steam generator shall be provided with provision for future Pneumatic Spreader for bagasse and spreader stoker for grate boiler.

The bottom of the second pass in the furnace will have bottom ash hoppers with refractory.

The firing floor will be of 8 mm thick minimum, MS fabricated grating with synthetic enamel painting.

Ash hoppers are to be provided below each furnaces and the steam generator height to be adjusted such that belt can be placed below ash hopper for quick removal of ash and shall be at the elevation of + 2500 mm. or more. By pass arrangement to be provided with ash discharge hopper.

Furnace to be of water-wall membrane type.

2.9 Fuel Firing System

The Steam generator is to be designed for firing slop with bagasse/coal . Separate fuel feeding systems for bagasse & coal and slop to be provided.

2.9.1 Fuel Feeding System

- Layout / design should provide for bagasse & coal firing system, silos, required furnace openings and account for its load on existing columns.
- The structural design should accommodate the weight of the feeding system which will come over the silo. The same will be 5 tons per column including static and dynamic load.
- Coal firing system to be provided. This will include coal sizing and handling system from coal yard, bunker sized for 12 hours storage with 80% filling factor and density of 600 kg/m³, appropriate feeder system regulated by VFD, mechanical spreading system for grate boiler, fuel feeders to be N+1 sized. The coal feeding system should have round cross section for all pipes / chutes and same to be in SS construction.

- Spent wash will be sprayed at high pressure to create required mist and suspension. The spent wash gun will be provided with steam flushing arrangement for online cleaning. Spare gun will be provided as stores supply.

2.9.2 Firing system / Travel Grate System

Front discharge travelling grate with individual hydraulic or planetary gearbox with VFD, complete with front plate, seals, grate casting, carrier bars, skid shoes, skid rails, sprockets, shafts, bearings, forged chain links and structural framing suitable for mounting on foundation.

- ◆ This system must maintain continuous tension in order to run smoothly and avoid jamming of the grate and grate bars. The catenary grate should be self tightening and should not require any expensive maintenance labour or external mechanical tightening devices, counter balances, or springs to maintain grate tension.

Travelling Grate System components specifications / requirements.

- ◆ Grates : High quality, heavy duty, heat resisting alloy CI or IS 3355 Gr. 1 type C
- ◆ Grate Air Seals: Under grate, front & rear air seals of Cast Iron and Carbon Steel, self adjusting to maintain continuous close seating contact with the Grates. Should be bolted type.
- ◆ Forged Chain Links: To be fabricated from forged steel with hardened roller and pin assemblies designed for high heat duty and tension loads.
- ◆ Grate support: Through underlying grate bar – should not damage even if debris fall on the grates. The grate bar should be Rolled-T type made out of EN-24 or IS 3355 Gr. 1 type C or IS 210 Gr.20
- ◆ Graphite Bearings: Heavy duty graphite carbon bearings which do not require any lubrication.
- ◆ Hydraulic / Planetary Gear box with VFD: Low Horse Powered, self contained and mounted directly to the stoker drive shaft at the stoker front. Should be capable of regulating to control the grate output from 0 to 48 feet per hour. Should also have necessary oil cooling arrangement.
- ◆ Stoker Front & Housing : The stoker should have a steel main stoker front plate with inside refractory combined with a dust tight front ash discharge extension housing.
- ◆ Pneumatic air swept distributors: Cast Iron Air Swept Fuel Distributor assemblies mounted on the Stoker front Plate and designed to assure uniform fuel distribution in the furnace. This should have a trajectory plate.

Other requirements of the Travelling Grate System

- ◆ The Grate Area loading shall be about 2.3 Million Kcal/hr/m²
- ◆ Thermocouples to be provided in the undergrate area to monitor the grate temperature.
- ◆ The total combustion air form by the FD fan, heated in the steam air pre-heater to a temperature of about 200⁰C. The undergrate air shall be uniformly distributed under the grate. This

distribution shall take into account the non uniform fuel distribution that could occur during the combination firing or during part loads.

- ◆ The secondary air for distribution and for the over fire air (OFA) shall be supplied by the secondary air fan and the SA fan shall take suction from the air outlet of the air pre-heater for hot SA design, if envisaged. The secondary air handled by the SA fan shall not be less than 25% of the total. The number of OFA levels shall be decided based on the requirements for bagasse / coal firing and there shall be provisions to cut of the levels, if necessary. The OFA pressure shall be selected to give a minimum penetration depth of two third the furnace dimension along the OFA jet.
- ◆ The travel grate structure and the travel grate are to be ensured not to sag due to increased width or other factors. Indication to measure the chain sagging has to be provided.

Firing system consisting of;

Continuous fuel feeding system:

- a. Coal bunker of minimum 12 hours storage.
- b. Bagasse silo for about 7 minutes storage.
- c. Fuel extractors with Variable frequency drives
- d. Screw feeders with constant speed electric drives
- e. Air swept / mechanical fuel distributors with trajectory plate
- f. The hydraulic drive system shall have overload protection.
- g. Only carbon graphite bearings acceptable.
- h. All bearing will be provided with protective seals to prevent ingress
- i. The firing system shall consist of spreader stoker with continuous ash discharge travelling grate with variable speed hydraulic / planetary drive. The hydraulic drive system shall have a stand by hydraulic pump and overload protection. The drive will be by a continuously variable hydraulic pump system and not of ratchet & pinion type. The grate assembly shall include the keys, air seals. rails, lubrication system etc.
- j. The seals to be provided under the grate shall be easily approachable for adjustment and replacement.

2.10 Economiser

Economiser will be placed after the external evaporator bank. Evaporator will be provided with 150 mm transverse pitch.

The flue gas velocity over the economiser tubes shall be limited to a maximum of 1 meter/sec. Suitable number of soot blowers shall be located in the economiser for effective cleaning of the heat transfer areas. For the purpose of maintenance and for accommodating the soot blowers the economiser may be divided into suitable number of banks. Broadly the individual bank height could be maintained at about 2000 mm with the interbank gap at about 600 mm.

The economiser shall be complete with seamless inlet / outlet / intermediate headers with drains and vents, coil supports, supporting structures for the complete economiser, interconnecting piping for the inlet and the outlet, access galleries and stairs, etc.

The economiser casing shall be of at least 6 mm thick, mild steel plate suitably stiffened / reinforced.

The economiser gas path shall be of the pressure tight construction with the proper design of the seals at the tube penetrations with the casing. The inlet and the outlet headers are adequately supported and anchored to take care of the loading from the connected piping.

The economiser tubes shall conform to SA 210 Gr.1. There shall be a minimum of two headers and the header material shall be conforming to SA 106 Gr.B or BS 3602 Gr.360 HFS.

An economiser of suitable heating surface shall be provided for steam generator. The economiser shall give rise in feed water temperature below saturation temperature of steam at design value when supplied with water of 135°C (normal).

The economiser shall be complete with tubes/economiser coils, supports, inlet and outlet water temperature, casing and dusting, soot blowers, lagging, vents & drains.

Velocity of the feed water in economiser tubes/coils shall be about 0.5 to 0.85 m/sec. The economiser shall be designed in accordance with the requirements of I.B.R.

To avoid corrosion from incoming flue gas, the economiser will be provided suitable cascade baffles or / and sacrificial empty coils or / and SS cladding on first array of coils.

Ash hoppers will be provided at bottom of economiser with refractory lining. RAV will be provided of minimum 400mm.

2.11 Air Pre-heater

Configuration of HRU's to be based on bidder's experience with slop fired boilers. Combustion air will need to be pre-heated. The same can be achieved by external steam heated APH or combination of steam heated APH with conventional tubular APH with clean air in tubes. In case of conventional APH, 2.34 mm tubes to be used and corten steel tubes to be used to prevent cold end corrosion. Ferrules to be provided at entry for erosion protection. Refractory lined ash hopper with RAV to be provided.

Air pre heater will be steam heated to raise the combustion air temperature to about 150 to 200 Deg C. Steam for SCAPH will be taken from turbine extraction steam. Fin tube heat exchanger to be utilised. Design should be to have minimum pressure drop of not above 20 mm wc. Condensate from the SCAPH will be returned by bidder to condensate transfer tank. Filter to be provided for air suction duct with cleaning arrangement.

2.12 Electro Static Precipitator (ESP) / Bag Filter

ESP / bag filter will be preceded by an ash collection chamber with refractory walls. Hoppers with SS lining and RAV will be provided. RAV to be minimum 400 mm.

A suitable ESP so that the fly ash contents of flue gases leaving the chimney conform to the rules and regulations of the pollution act as applicable to the factory. ESP/ bag filter to be designed for 50 mg/Nm³.

It shall be the responsibility of the steam generator manufacturer / Bidder to provide all technical documents, as required, to pollution control authority.

The ESP / bag filter shall be installed on the suction side of the I.D. fan and shall to be complete with rotary airlock valve with drive provided with local and remote push button control, and a slide manual gate. The minimum elevation of discharge flange of the rotary airlock valve shall be at + 2500 mm. Hoppers with refractory lining and RAV will be provided. RAV to be minimum 400 mm.

"All parts exposed to flue gas will be of corten steel or anti corrosive steel".

Suitable platform, ladder, inspection & poking holes, vibrators, etc., shall be provided to facilitate regular inspection and cleaning of the ESP.

Even with one field of ESP out of service the ESPs must remain in operation. Manufacturer / bidder to specify the emission level with any one field out of service at 100% boiler MCR with Indian coal as fuel. Bag filter to be designed with 20% additional surface area than required to permit longer operations during some bag failures. Minimum guarantee of 12 months for bag life to be provided and any failure during this period will require free replacement by bidder.

All electricals including MCC, rectifiers, panels, electricals & control cables, earthing etc. in bidders scope. Control shall be from control room. Hopper to be provided with RF type level switches for Hi & Hi-Hi levels. Status from operation of all trafos, rapping panel, RAVs, hopper levels to be provided in DCS. The logic of the signal will be to trip the ESP and operate the ID fans on purge mode.

The manufacturer is to design & supply suitable flue gas cleaning system to ensure that the flue gases entering the chimney do not contain SPM in excess of 50 mg/Nm³.

2.13 Induced Draught Fan

There shall be one (1) ID Fans designed with minimum 10% margin over and above 100% MCR flow at about 200⁰ C. ID fan should have minimum head margin of 20%

The ID fan shaft shall be both end supported, directly driven type, and complete with drive equipment etc. Fan material design as per IS : 1570 - 1979.

The ID Fan maximum speed shall not be more than 1000 rpm.

Renewable hard faced wear pads on blade shall be incorporated in the impeller. Alternatively, erosion resistance nickel chrome steel to be used. The blade of the fan rotor should be fabricated out of minimum 5 mm thick mild steel plate. After hard facing, the thickness should be minimum 14 mm. ID fan blade will be of backward vane type. Outlet damper for maintenance isolation to be provided. The end plates of the rotor shall not be less than 10 mm thick M.S. Plate.

Multi-louver damper to be provided for manual control.

The rotor of the ID fan shall be dynamically balanced and tested for its parameters at their works and test certificate and inspection certificate to be provided. The rotor shall be dynamically re-balanced at site if vibration levels exceed limits.

Induced Draft Fan Drive

The ID fan shall be driven by an AC Motor drive with variable frequency variable speed control system (VFD).

The Drive unit shall be complete with control equipment, speed meter, voltage, amp., frequency indicators, etc.

All electrical control accessories to be included.

2.14 Forced Draught Fan

There shall be 1 x 100% FD fan with 10% margin over and above 100% MCR flow. Bidder may consider separate base plate arrangement for fan & motor. The Forced Draft fan shall be horizontal, radial and with backward curved blades. The fan shall be supplied complete with motor, base plate for motor and fan, coupling, etc. The fan shaft shall be of simply supported design, conforming to C-35 for IS-1570-1979 material. The minimum thickness of the aerofoil blades used in the construction of the fan shall be minimum of 5.00 mm. The fan design temperature shall be 50⁰C.

The forced draft fan is to be designed for 20% margin on head.

Inlet guide control for the fan to be provided.

The F.D. fan material shall confirm to I.S.- 1570, 1979.

The F.D. fan shaft shall be both end supported, directly driven type, and complete with drive equipment etc.

The F.D. fan maximum speed shall not be more than 1500 / 1440 rpm.

The blade of the fan rotor should be fabricated out of minimum 5 mm thick mild steel plate. The end plates shall not be less than 8 mm thick MS plate.

A thick welded mesh screen shall be provided before the damper to avoid accidental entry of foreign material. The entry of FD fan will be on the Y axis with suction from atmosphere.

The direction of rotation of the FD fans shall be same where more than one fan is provided.

The rotor of the FD fans shall be dynamically balanced and tested for its parameters at their works and test certificate and inspection certificate to be provided.

The rotor shall be dynamically re-balanced at site if the vibration levels, are found unacceptable.

Forced Draft Fan Drive

Signature and Seal of the Bidder

HBL/TEN/PUB/20-21/223 dated 06.02.2021

Page 114 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

The F.D. fan shall be driven by a variable speed electric drive.

a) A.C. motor drive - with variable frequency / variable speed control system. (VFD)

The drive unit shall be complete with control equipment, speedo meter, voltage, amp., frequency indicators, operator's control cubical local (lockable) and remote (control room) etc.

The electric system to be complete with all electrical protections & control devices.

FD fan to have multi louver dampers. The multi louver damper to be pneumatically controlled through DCS.

Both the ID and FD fans should be interlock so that FD fan can be started only when ID fan is running.

2.15 Performance requirements for Fans

Noise and vibration

All equipment and their accessories shall perform continuously with the levels of noise and vibration as specified below :

All equipment shall provide acceptable and not excessive back ground accoustical level. Measured noise level produced by any rotating equipment or a group of equipment closely located shall not exceed 90 db (A) at a distance of 3 m from it in any direction.

2.16 Secondary Air Fans

The Secondary fans shall be of constant speed, horizontal, radial, backward curved or aerofoil bladed and electric motor (squirrel Cage TEFC) driven. The fan flow control shall be with VFD. The fan shall be direct driven, with speed not exceeding 1440 RPM and shall be supplied complete with motor, coupling.

The supply of SA air to the furnace should be through SS nozzles or with required expansion bellows considering the heated air temperature.

The SA fan is to be designed for a minimum discharge capacity of 10% higher than required at peak load capacity and 20% margin on head.

The SA fan shaft material shall conform to C40 forged to I.S. - 1570, 1979.

The SA fan shaft shall be both end supported, directly driven type and complete with drive equipment etc.

The blade of the fan rotor should be fabricated out of minimum 5 mm thick mild steel plate.

Variable inlet vane control dampers in the suction of the SA fan should be provided. A thick welded mesh screen (applicable for cold SA) shall be provided before the damper to avoid accidental entry of foreign material.

The direction of rotation of the SA fan shall be same where more than one fans are provided.

The rotor of the SA fan shall be dynamically balanced and tested for its parameters at their works and test certificate and inspection certificate to be provided.

The rotor shall be dynamically re-balanced at site if the vibration levels exceed limits.

Multi louver damper control to be provided for SA fans. The multi louver damper to be pneumatically controlled through DCS.

The SA fans configuration per boiler will be 1 x 100 %.

2.17 Blow Down Arrangements

Continuous blow down equipment as per I.B.R./I.S.O. complete with all piping, fabricated blow down tank, located at a suitable distance from the steam generators (Approved by the purchaser / consultant). Bidder in accordance with IBR will provide one intermittent and one continuous blow down tank.

All blow down piping shall be as per I.B.R. and provided with supports and slope etc., Adequate slope from the pressure parts outlet connections and minimum nos. of bends shall be provided to ensure that the system remains free from the blockages. All blow down piping in bidders' scope. Blow down valves to be motorised. Flash steam to be recovered to deareator.

2.18 Soot Blowing Equipment

Steam operated and auto controlled soot blowing equipment with adequate number of soot blowers for the steam generator at appropriate places to cover bank of steam evaporator tubes, all pressure parts and superheater elements shall be provided.

Additional soot blower (s) shall also be provided for the economiser.

All soot blowers will be motorised and logically controlled.

All steam piping for soot blowing in bidders scope.

A suitable pressure reducing valve & system shall be provided for required steam for soot blowers. The steam will have atleast 50⁰C superheat, as being used for soot blowing and will be tapped from the primary superheater.

The steam generator shall be provided with a complete system of soot blowers to effectively dislodge deposits from the heat transfer areas. The soot blowers shall be motor operated with steam, taken from the steam generator, as the cleaning medium. The required pressure reducing station with pressure

controller and pneumatically operated control valve and downstream safety valve shall be provided. The supply shall include all piping, fittings, valves, traps etc.

The radius of cleaning in the evaporator and super heater area will cover 100% of the tubes.

In the zones where the gas temperature exceeds 700⁰C only long retractable soot blowers shall be given. For the blowers located in zones where the gas temperature exceeds 400⁰C, the material shall be a minimum of stainless steel type 304.

The entire soot blowing system will be auto controlled and operated with all controls through the plant DCS or independent PLC. Tumbling hammers may also be provided.

2.19 De-aerator & Deaerated Water Storage Tank and Condensate Storage Tank

All spray nozzles of deaerator should be of stainless steel materials. The design inlet water temperature to be 30⁰C. Level & pressure control valves to be provided, to sustain & maintain the design quality of DA water. Deareator to be sized for 125 % of MCR and storage tank for 20 minutes MCR. Deareator outlet temperature to be 150 deg C, with normal operation with extraction steam and start-up from primary super heater header.

The maximum dissolved oxygen in the de-aerator water shall not be more than 0.007 ppm. at 110⁰ C after LP dosing.

The de-aerator storage tank shall be installed as per requirement of NPSH and on its own structure.

The water outlet (suction line of pumps) to be provided with all perforated pipe inside the tank along its full length or with suitable vortex breakers.

The drain valves for feed and de-aerated water tank shall be at elevation of + 2000 mm from F F L and terminated at the common drain (factory drainage system.)

A full range plate type level gauge glass is to be provided.

The high and low water level indicator and alarms shall be provided. Auto control is required from plant DCS.

Feed water control station will consist of 1 x 100% pneumatic control valve, 1 x 100% motorised control valve and 1 x 30% manual bypass. Control station to be at operating floor level.

Elevation of deaerated water storage tanks shall be as per bidder's design and as per NPSH requirement.

Condensate transfer tank of 50 m³ capacity to be provided near deareator. This tank will receive process condensate from the distillery. Design of tank to be as per IS:803-1976, MOC:IS:2062, with external 2 quotes of red oxide and anti-corrosive epoxy paint and to be provide with level indicator, level transmitter for transfer pump operation through DCS, air vent, drains overflow etc. NPSH to be suitable for 100 Deg C. Online pH and conductivity monitoring with alarms in DCS to be provided for return condensate.

Two transfer pumps (1W+1SB) to be provided to transfer the condensate to deareator, continuously. Pumps to be of 15 m³/hr with required head to transfer to deareator, with minimum re-circulation line. Transfer pumps to be located below condensate tank. The deareator, condensate storage tank, condensate transfer pumps and boiler feed pumps can be located on the same structure.

2.20 Boiler Feed Water Pumps

Electrical Driven Feed Water Pumps

Nos. of Pumps : 2 Nos. (2 x 100%) with VFD.

Each multistage electrical driven pumps set shall be suitable for pumping hot water at 150°C from deaerator to steam generator.

Auto circulation valve (with required arrangement) to be separately provided for each pump. Capacity of auto leak valve to be given by bidder. The ARC valve will be of Schrodhal make. On the suction side, one operating and one isolation valve shall be provided.

The balancing chamber relief line shall be provided with the pressure gauges for each pump and pipe line laid separately for each pump. Only, mechanical seals to be provided.

Each pump should be provided with in-line strainer in the pumps suction line. Pressure transmitter to be provided across each strainer and interconnected to DCS, with analog signal.

The pump and the drive (Electrical Motor) shall be placed on RCC foundation at a foundation level of +500 mm.

The steam generator feed water pumps should be sized to include the flow need of the steam generator, 3% blowdown, 1% losses/unaccounted and 6 – 8% margin for volume. Head to be sized as per bidders design with atleast 5% margin. All margins to be at 110% MCR.

Header will be provided at boiler feed pump discharge with required tappings for feeding to economiser, minimum re-circulation and requirements of DSH in auxiliary PRDSH, attemperator and exhaust PRDSH. Inter stage tappings to be provided for PRDSH. PCV to be before DSH and one pipe length after DSH to be of MOC of upstream pressure (44 ata)

The boiler feed water pumps to be located below deareator.

- **Chemical Dosing System**

Steam generator shall be provided with a tri-sodium phosphate based High Pressure (HP) dosing system and a hydrazine and ammonia based Low Pressure (LP) dosing system.

The HP dosing system shall add the chemical to the steam generator water to take care of the ingress of the hardness salts and to increase the steam generator water pH. The LP dosing is done to the feed

water preferably at the outlet of the deaerator or to deaerator to scavenge the last traces of oxygen and to increase the feed water pH.

Each dosing system shall include a stainless steel mixing tank with an electric motor agitator. Each system shall have 2 x 100% capacity, motor driving positive displacement type pumps, with wetted parts made of stainless steel, with facility to vary the feed rate.

The HP and LP dosing systems shall be mounted on individual skids with their respective tank, pumps along with all required piping, valves, fittings, supports etc.

The complete piping for both the HP and LP dosing system from the skid to the respective admission points to the steam generator water circuit shall be SS 304.

2.21 Instrumentation

- **General**

Bidder shall prepare and submit a P & I Diagram for the system within the scope of his supply, showing all the instruments and alarm / interlock / trip operations. Each instrument shall be given individual tag numbers.

Instrumentation shall be complete in every respect and liberal to the extent of providing data on all operation variables sufficient for the safe efficient, easy operation, start up and shut down of the plant.

The complete steam generator & auxiliaries' packages will be normally operated only through the DCS in the control room. It is not envisaged to have any operator or workman in the field. Normal start-up operation should also be accomplished through the DCS. Hence, start / stop of all drives, speed regulation where required, operation of actuators / dampers / solenoid valves, operation of all motorised valves, operation of sub-systems like soot blowers, etc. should all be interconnected through the DCS with appropriate & required I/Os.

All instruments and equipments shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and / or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof, weather proof to NEMA 4 (IP:55) and secure against the ingress of flue, dampness and vermin. All external surface shall be suitably treated to provide anti-corrosion protection.

The instruments like control valves, thermo wells, orifice flanges, level instruments etc. coming on pipes and vessels under IBR shall be certified by IBR.

Location of tap off connections shall be either from the side or from the top of the steam generator equipment but not from the bottom. This requirement is applicable to both pipes and vessels. The location of lower side connection shall be high enough to prevent plugging due to dirt or other suspended solids. In addition, the connections shall be short, vertical or horizontal and without any pockets.

Materials of construction of instruments shall be consistent with temperature, pressure, corrosion conditions and other steam generator requirements.

Instrument power circuits shall employ an isolation transformer and individually protected from fault with the help of MCB's and fuses. Power supply to the individual instrument shall be disconnect able with the help of switch and protected with the help of fuse.

Ranges for instruments shall be selected, in general, such that in normal process operation the indication on the indicator or chart is between 40% to 60% of span for linear and 60% to 90% of span for square root.

The complete instrument system shall be designed for safe operation, by using normally closed contacts which open on fault conditions.

Adequate alarms shall be provided to give audible and visual warning of malfunction. The Bidder shall also provide alarm contacts for the operation of parallel alarms, common pre-alarm and shut down alarm by the Purchaser wherever indicated.

All lamps shall be provided with lamp test facility.

Gauge glasses shall be provided for all level measurements requiring automatic or manual control or monitoring. They shall have at least the same pressure and temperature rating as that of equipment's on which they are to be installed. They shall have ball / plug valves for isolation.

Isolation and bypass valves shall be installed with all control valves. Hand wheels and air lock valves shall be considered for all control valves.

Control valve sizing formula shall, in general, be as per ISA-75, 07. Control valves shall be sized for the available pressure drop at normal flow and shall permit up to 110% of the maximum flow. The Bidder shall submit the sizing calculations for all control valves. DP shut off shall be 10% more than upstream pressure for actuator sizing.

Orifice plate calculations shall in general, follow BS 1042. Orifice diameters shall be selected so that d/D ratio is between 0.2 to 0.7 for gases and steam and up to 0.75 for liquids. Bidder shall submit the sizing calculations for orifice plates.

Main steam generator isolation for air vent valve will be motorised and all valves shall be designed in accordance with ASME code for steam generators and pressure vessels and Indian Boiler Regulations.

All transmitters shall be provided with output meter/output gauge at the transmitters end. All transmitters will be smart type, with Hart communication.

The Bidder shall ensure that the packing of instruments and associated equipment is adequate to prevent damage from such contingencies as rough handling, weather, condensation, dew, vermin and vibrations.

All solenoid valves shall be universal type and continuous rated type.

Wherever applicable, instrument junction boxes shall be provided. Drawing shall be furnished separately for wiring and tubing for showing all instrument interface details.

2.21.1 The steam generator shall be provided with a three Elements Automatic Feed Regulator (through transmitter and controllers).

2.21.2 De-aerator Automatic Level and Pressure Controller

2.21.3 Remote Water Level Indicator for steam generator to indicate the water level in the steam drum and visible at the operating floor.

2.21.4 Furnace draught control system will be provided to automatically control the ID dampers to maintain design furnace pressure. Aerofoil measurement of combustion air interconnected to DCS to be provided.

2.21.5 INSTRUMENTS

The DCS shall be employed for the following and will be suitably interconnected within bidder's battery limits.

1. Closed loop controls of parameters for operation of boiler and turbine.
2. Open loop controls.
3. Sequence and shut down logic of boiler.
4. Continuous monitoring of process parameters and drive running status.
5. Mimic graphics
6. Trends
7. Report generation
8. Alarm logging
9. Event recording

Following closed loop controls shall be implemented in DCS:

- i. Three element control
- ii. Level control
- iii. Combustion control
- iv. Superheated steam temp. control
- v. Furnace draft control
- vi. Deaerator level and pressure control
- vii. CBD/IBD level control

Open loop control

Operation of Motorised control valves and dampers for –

- i. Boiler feed water pump
- ii. Main steam stop valve and its bypass valve
- iii. Air vent valve
- iv. ID, FD, SA fan inlet dampers
- v. Start/stop critical drives

Monitoring of following process parameters of boiler :

1. Flow :
 - vi. Boiler outlet steam
 - vii. Boiler feed water
 - viii. Combustion air

2. Pressure :
 - ix. Boiler outlet steam
 - x. Drum
 - xi. Deaerator

3. Draft :
 - xii. FD fan outlet
 - xiii. ID fan inlet
 - xiv. SA fan inlet
 - xv. Furnace
 - xvi. Flue gas at evaporator outlet
 - xvii. Economiser outlet

4. Temperature :
 - xviii. Feed water at deaerator inlet & outlet
 - xix. Feed water at economiser inlet and outlet
 - xx. Boiler outlet steam
 - xxi. Flue gas at furnace outlet
 - xxii. Flue gas at economiser outlet
 - xxiii. Flue gas at air heater outlet
 - xxiv. Flue gas at ID fan inlet
 - xxv. Slop fed to boiler

5. Current :
 - xxvi. ID fan
 - xxvii. FD fan
 - xxviii. SA Fan
 - xxix. Boiler feed pump 1&2

6. Positions :
 - xxx. Positions of all inching MOVs

7. Level :
 - xxxi. Drum
 - xxxii. Deaerator
 - xxxiii. IBD
 - xxxiv. CBD

8. Speed :

- xxxv. ID fan
- xxxvi. FD fan
- xxxvii. Rotary drum feeders
- xxxviii. Coal feeders

The I & C to provide for the following recording to occur in the plant DCS.

- **Parameters to be measured for recording in DCS :**

- Steam Pressure (also indicating)
- Steam temperature (also indicating)
- Feed Water Temp. of Eco. inlet (also indicating)
- Feed Water Temp. of Eco. outlet (also indicating)
- Drum Water Level (also indicating)
- Feed Water Flow (also indicating & Integrating)
- Air Temp. at APH Outlet (also indicating)

- **Alarms to be interconnected to plant DCS :**

- Drum Water Level Very High & Very Low Alarm-Audio & Visual
- Drum Water Level High Alarm - Audio & Visual
- Drum Water Level Low Alarm - Audio & Visual
- High Steam Temp. Alarm - Audio & Visual
- Low Steam Temp. Alarm - Audio & Visual
- ID, FD, SA Fans Trip Alarm - Audio & Visual
- BFW Pump Trip Alarm - Audio & Visual
- Fuel Feeders Trip Alarm - Audio & Visual
- Low Deaerated Storage Tank Level - Audio & Visual

- **Temp. Indicator (simultaneous indication of all the points) & for Air interconnected to plant DCS.**

- APH – Outlet

- **Temp. Indicator (simultaneous indication of all the points) & for Flue Gas interconnected to plant DCS.**

- Furnace - Just above the grate
- Furnace - Combustion zone
- Furnace - Superheater flue entry zone
- Super heater outlet
- Evaporator Outlet
- Economiser outlet
- I.D. Fan Outlet

- **Temp. Indicator (simultaneous indication of all the points) and for Water interconnected to plant DCS**

- Eco - inlet
- Eco - outlet
- **Draft transmitter and interconnected to plant DCS**
 - Furnace
 - Super heater inlet & outlet
 - Evaporator Outlet
 - Eco Outlet
 - ID Fan Outlet
 - Plenum
- **Oxygen analyser after economizer**
- **AMP. (CURRENT) Indicator interconnected to plant DCS**
 - ID Fan Drives
 - FD Fan Drives
 - SA Fan Drives
 - BFW pump drives

- **AMP. (CURRENT) Indication**

All other motors in Steam generator Station - individual indicator at respective MCC

- ON - OFF Indication of the Soot blowing operation showing individual location of Soot blowing, interconnected to DCS, with logic control for auto time based operations.
- Fuel Feeder Speed Control Units, interconnected to DCS.
- ON/OFF - Push Button Units for all rotary Air Lock Valves
- Any other required for the proper and efficient combustion control and operation of the Steam generator.

2.21.6 Local Instruments

The steam generator shall complete with the minimum following local instruments.

Steam Pressure indicator	One on each side Steam generator drum.
Steam Pressure indicator	One on each side of Super Heater and one at Steam generator Firing Floor
Steam Temp. indicator	One on each side of Super Heater (with

	additional thermowells), and one at Steam generator Firing Floor
Feed water temp. indicator	One each at Eco inlet and Outlet One near Feed Water Control system
Feed Water press indicator	One each at Eco Inlet and Outlet One near Feed water control system
Feed water flow indicator	One near the Flow control system
Flue Gas temp. indicator at	Furnace - 3 places - Steam generator Outlet - Eco Outlet - ID Fan outlet
Air Temp. indicator at	- APH – inlet - APH Outlet
Drum Water level indicator	(level gauge) - 2 Nos. independently connected to the Drum on each side of the stream Drum. One remote type at Firing Floor Level.

2.21.7 Bidder to supply loose, flue monitoring analysers for SPM, SO_x and NO_x with interconnection to DCS.

2.21.8 Necessary tapping arrangements with thermo wells to measure the temperature of air, gas, steam and toppings to measure draft with manometer shall be provided.

2.21.9 Other General Points

- All required safety interlocks shall be incorporated in instrumentation system.
- All control valves power cylinders for dampers shall have airlock facility.
- The following drives shall have start / stop facility from the DCS. Illuminated push buttons shall be used.
 - FD Fans
 - ID Fans
 - SA Fan
 - Fuel Feeders
 - BFW
 - Slop supply pumps & control valves
- In addition to the instrumentation recommended whatever additional instrumentation is required to prove the performance of their equipment shall be included in the Bidder's scope.

2.22 Electrical

The motor ratings for all pumps and fans will be atleast 10 % higher than the maximum KW rating of the driven equipment. All motors to be energy efficient. Efficiency class of all LV motor shall be IE2 except VFD application motors, crane duty motors and MV motors. Temperature rise to be as per IS / IEC Standards. The steam generator station shall be have indoor type MCC's and shall be provided with one number incoming switch 1.2 times the connected load including the stand by equipment, an ammeter, a volt meter with selector switch, on and off indicating lamps, energy meter etc.

The purchaser before commencement of its manufacture shall submit the single line diagram of the Electrical Panels & Distribution system for approval.

- **Other instrumentation requirements**

- a) Steam flow, air flow metering;

Measurements should be pressure and temperature compensated.

- b) Soot blow steam pressure reducing station.

- c) Impulse piping (As per IBR for steam and high pressure water applications)

- Isolation valve near tapping
- Isolation valve near junctions
- Isolation valve near flushing and drawing points

- d) All Draft Points

Provision for clearing the tapping and for flushing the piping from field or panel.

- e) Manual hand Wheel operation

Provision for all control valves and dampers

- f) To provide drain points in the air line.

- g) Air piping - Sloping towards start point to avoid moisture collected from entering the instruments.

- h) .All field instruments should be covered with FRP or PVC covers to protect from rain, spillages from nearby equipments.

- i) Solenoid valves should be of 24 V DC coil type.

- **Motor Feeder Starter Modules**

Motors controlled by VFD will be with VPI/trickle impregnation and double enamel coating. They will be with thermistors for winding and suitable thermistor relays in the panels.

All motors for fans, boiler feed water pumps, slop feed pumps, cooling water pumps and fuel feeders will be with VFD to save auxiliary power. Additional specifications are provided in the electrical section.

- **Interconnections**

Power interconnections inside the panel shall be done with 1100 V grade single core PVC insulated copper conductor upto 63 Amps rating by aluminium flats. Control wiring shall be done with 650/1100V grade PVC single core copper conductors of minimum cross section 1.5 sq.mm.

- **Indicating Instruments**

The meters shall have a scale with compressed overload range so as to permit estimating of starting current of AC motor. Ammeters may be directly connected for currents up to 50A full load current and ring type current transformer shall be used for higher currents. The meters shall be of :

- 144 mm dial size for Incomes
- 96 mm dial size for motor feeders with suppressed scale to indicate motor starting current.
- Black numerals with a white dial free from parallax errors.
- Square pattern.
- Flush mounting.
- With provision for zero adjustment outside the cover.
- With incomer ammeter and voltmeter with selector switch.

- **Pilot Lamps**

The indicting lamps shall be :

- LED and of low watt consumption easily replaceable from the front.
- Provided with series resistors.
- Provided with translucent lamp covers of the following colours, easily replaceable from the front.
 - RED for 'OFF';
 - GREEN for 'ON'

- **Painting**

All metal scrubber shall be chemically cleaned, degreased and pickled in acid to produce a smooth surface, free of scale, grease and rusts.

After cleaning, phosphating and passivation treatment, the surface shall be given two(2) coats of zinc rich epoxy primer and backing in the oven.

Sufficient quality of touch up paint shall be furnished for application at site.

- **Marking Of Wires, Cables And Modules**

All wirings and cables at the terminations at the switchboard shall have distinct marking by means of ferrules with letters/numerals printed corresponding to the working diagram to be furnished by the successful bidder.

All labels shall comprise white letters on a black background; the size of the lettering shall be 6 mm.

The switchboard shall carry the following distinct marking / nameplates.

- The manufacturer's name / brand name.
- The module Nos. with the load designation and rating of the module in KW/Amps.
- Danger boards as per the IE rules and the statutory regulations of the Range Electrical Inspector.

- **Tests**

The panel shall be subjected to following tests (Alternatively type test certificates for similar MCC / panel to be provided) :

- Mechanical operation test.
- High voltage test.
- Electrical control, interlock and sequential operation test.
- Verification of wiring as per approved schematic type tests and routine tests shall be carried out on all associated equipment as per relevant standards.
- Certified copies for all type and routine test. Certificates shall be submitted for the Purchaser's approval before despatch of the switch gear.
- Type test reports for identical equipments shall be furnished with drawings. Heat run test and type tests as per IS 2026 shall be conducted on Gen. transformer at manufacturers works.
- Impulse test shall be carried out on all three phases of H.V. winding and LV winding of the Gen. transformer.

- **Local Push Button Stations**

Local push button stations shall be provided near each drive motor for disconnection of the motor from its supply in case of an emergency and during maintenance as per Indian Electricity Rules. These shall have key lockable OFF push buttons in dust and oil tight enclosure made of die cast aluminium.

2.23 Material of Construction, General Instructions and Scope of Piping

2.23.1 Steam generator shall be complete with necessary tubes, manifolds integral pipe work, mountings and fittings with valves, gauges high and low water alarm, drum level control with three element system.

2.23.2 Maintenance tools consisting of tube expanders, mandrills, ratchets, two grease guns, a set of spanners, water gauge glass assembly with glasses, and chemical injection valves etc.

2.23.3 The integral pipe work shall consist of blow off bends, high and low pressure drains, water gauge piping, water and steam connections to feed water regulator, feed pipe work from feed control valve to

economiser inlet manifold, feed pipe work from economiser outlet manifold to the steam generator steam pipe works, safety valves escape pipe works etc.

2.23.4 All the bends, elbows, ducts shall be suitably designed for to minimise the draft losses.

The Air & Flue duct will be provided with Man Holes, Cleaning holes for internal inspection, Cleaning & painting.

The entire ducting for Air as well as Flue shall be designed to achieve minimum bends, minimum change of cross section. If change in cross section is unavoidable, it must be very gradual. No dust accumulation should occur where ash hoppers to be provided.

All ash hoppers including hopper below Dust collector, APH, Holders, Drum, etc., shall be provided with steep angle (60 Deg.). All the ash hoppers shall be provided with rotary air lock valves. Ash hoppers having Rotary air lock valve shall have side cleaning inspection Doors / Main holes etc. ESP / bag filter to be provided with flat ash hopper design having valley angle more than 70 deg C.

2.23.5 Available galleries and ladders with gratings or open steel flooring for affording access to the essential levels of the steam generator plant complete with hand railing curb angles and supports shall be provided.

2.23.6 The marking in the pressure parts for measuring tramp expansion shall be provided. All the details of tramp expansion details shall be provided.

2.23.7 All supporting steel work, hangers thrust brackets and castings for the furnace would be provided for steam generator.

2.23.8 All Refractory, refractory cement, Special bricks, etc. shall be supplied by the steam generator Bidder. All refractory for high temperature will be as per IS8 and for the ducts as per IS:6.

2.23.9 All the necessary temporary lifting arrangements for drums, economiser etc., shall be supplied. If any re-calibration required for the steam generator instruments, the same shall be calibrated by the steam generator Bidder.

2.23.10 Refractory

All refractory materials including standard and high grade refractory tiles and bricks. Adequate quantity of high grade refractory cement, special shaped refractory tiles, castables refractory bricks for furnace and high temperature zones should be as per I.S:8. quality.

2.23.11 Insulation

High grade insulation materials suitable for outdoor steam generators shall be supplied. Ceramic blanket or mineral wool of multilayer with 22g aluminium cladding, water proof lagging and protected from rain water, wind and Dust etc. for the exposed portion of the steam drum, steam generator furnaces, integral pipe work from the feed pumps to the steam generators, steam & exhaust piping, hot

air & gas ducting, condensates pipes, valves having high temperature fluids, deaerated water tanks, and other steam generator accessories to be provided.

Glass wool materials is used should confirm to I.S. 3690 - 1974 type 2 mineral wool shall confirm to I.S. 5696 - 1970. The thickness should be to suit the diameter and temperature of pipes. The wire mesh should be of galvanised wire and lugs/pins used should be galvanised.

2.23.12 The detailed tramp expansion of the steam generator pressure parts corresponds to temperature from 30°C to the maximum designs working temperature shall be furnished. It has to be confirmed before safety valves testing to the purchaser.

2.23.13 Staging, Galleries and Ladders

- **Steam generator Structures**

The complete steam generator & the auxiliaries structural steel supports including the roof over the steam generator and side cladding from the top to the drum operating floor, all foundation bolts & required templates for the same, base plates & insert plates for the structural shall be the responsibility of the Bidder. The Purchaser's responsibility ends with the finished floor level (except for the equipment foundations) and all the foundations required for the columns & supports shall be provided by the Purchaser. The complete structural work above the finished floor shall be of steel and shall be the total responsibility of the Bidder.

The required structural columns, frame for the economiser, air preheater ducting and piping equipment, stair cases to steam generator drum level, soot blower locations, deaerator, access openings shall be provided with liberally sized stairs, handrails and walkways.

In addition, pipe supports, hangers, duct supports, etc., shall be provided for the complete systems covered in this specification.

The steam generator and its accessories will be provided with steel supporting structure made from rolled steel sections, having adequate strength for the loads imposed by the steam generator and associated equipment. These will be including supporting columns, integral floor structure, with gravity or open steel flooring stair cases / ladders, hand railing, curb angles supports etc., for affording access to the essential levels of the steam generator plant. All supporting steel work, hangers, thrust brackets etc., shall be provided.

All gangways, passages, stair cases / ladders, working platforms and railing shall be provided. A clear working platform of minimum 750 mm to be provided for the steam generator at all levels. All statutory requirements regarding staging, platform/stair cases, safety devices etc. should be observed.

Interconnecting steel platform from boiler operating floor to the control room operating floor in the power house to be provided with handrails and steps.

The centre of the steam generator front steel supporting columns shall be minimum 2500 mm away from the centre line of fuel carrier.

The steam generator operating floor/working platform shall be minimum 10 meters wide from the steam generator front support columns in front of the steam generators and the control room. An approach ladder shall be provided from bagasse working platform to bagasse carrier working platforms at both sides.

The steam generator control room shall be located to avoid obstruction while furnace cleaning etc. The front wall of the control room shall be minimum 10 m away from the steam generator furnace doors.

One staircase to be provided with suitable platform on either side of the drum.

- **Platforms and Walkways**

Platforms, walkways, staircases and landings shall be provided for safe operation and maintenance of the steam generator and auxiliary equipment and in general conform to an acceptable and proven standard. Arrangement of platforms, walkways and landings shall provide safe access to all openings for inspection and cleaning purposes, permanent and test measuring points, control devices, local instruments, vents and drain valves, soot blowers, safety valves etc. Wherever possible platforms, walkways and stair cases shall be supported from unheated structures of steam generator or building and shall never be supported from pressure parts or other moving parts of the steam generator or other plant. Platforms & walkway panels and stair treads shall be made of structural steel open bar gratings.

Size of platforms shall be in such a way that the equipment to be attended shall be approachable from all sides, Minimum width of platforms and walkways shall be 750 mm. Minimum headroom above the top of platform or walkways should be 2200 mm.

- **Stairs and Ladders**

All stairs shall have a minimum clear width of 750 mm and the slope shall not exceed 45 °C with the horizontal. Minimum width of tread of staircase shall be 22 mm and the rise shall not exceed 200mm. Length of landing should not be less than 900 mm or the clear width of stair, whichever is greater. Maximum number of risers in a flight shall be restricted to 16. Treads on open stairs should overlap not less than 15mm and shall have a slip resistant nosing not less than 25mm wide.

Fixed ladders shall be provided to platforms / roofs, which do not require frequent access by the operating personnel. Ladders should preferable of a sloping type with a maximum inclination of 15 °C to the vertical. Clear width between strings shall be 415 mm. Minimum thickness of strings shall be 10mm. Rungs shall be MS rounds of 20mm diameter, spaced at 225 mm (min) and 275mm (max). Minimum clear space of 230mm shall be provided behind each rung to allow foot room. Wherever the height of the stair exceeds 6.0 metres an intermediate platform shall be provided. Safety cages shall be provided if the height of ladder exceeds 4.5 meters. The cages may start at a high of 2.5 meters from the lower level. The

diameter of the cage shall be 700mm (min) with 5 Nos. of 50 x 6 flats for vertical and 50 x 6 flat at a spacing of 900mm (max) for rings.

- **Grating For Platforms, Walkways And Stair Treads**

Gratings shall be of structural steel with a minimum depth of 25mm and a minimum width of 750mm and shall conform to BS;4952 Part I.

Minimum thickness of load bearing and spare bars shall be 3mm. Thickness of other binding bars shall be minimum 6mm. Clear distance between the load bearing bars shall not exceed 40 mm. for diamond pattern and 30mm for rectangular pattern. The deflection of grating panel shall not exceed span / 200 or 10mm whichever is smaller.

- **Handrails**

Top rail, knee rail and vertical post shall be 32mm NB (medium) tube conforming to IS:1239. The spacing of vertical post shall not exceed 1.2 m. The height of handrail shall be 1 m with rail at mid height. At platform and landings toe guard of 100 x 5mm shall be provided.

- **Joint Design**

Generally all shop connections shall be welded and field connection welded or bolted. All moment connections, if bolted shall be of High strength friction grip bolts. Shear and other minor connections, if bolted may be made with mild steel/high strength bearing bolts.

2.23.14 **General**

- **Steam generator Integral Piping**

The steam generator integral piping consists of all the interconnecting piping between the economiser inlet stop valve and the superheater outlet header. The number of size and the arrangement of these integral piping shall be based on the permissible pressure drops in these pipes and the distribution required in the respective headers of the various sections of the steam generator. These piping shall be properly supported and provided with the required tapping, stubs and thermo wells for measurements.

- **Sampling Facility**

Sampling Facility with sample coolers as required shall be provided for feed water, superheated steam, saturated steam and blow down water. There shall be individual sample coolers for each of the above applications with associated sampling lines, valves, cooling water lines etc. These shall be provided complete with drain tray, drain piping upto nearby drain trench.

- **Piping, Valves and Fittings**

Piping design will be as per ASME B 31.1. All piping required for effectively connecting the steam generator with the steam, feed water, and other systems shall be provided. The piping provided shall be complete in all respects including valves, fittings, supports etc. as required and include the following :

The Bidder scope shall include all necessary interconnecting pipe work between various units of the steam generator package. Necessary supporting materials, towers and trestles to support and anchor the pipelines at regular intervals shall be supplied. Suitable expansion loops and hangers shall be provided wherever necessary.

Complete soot blower piping from the tap off on the steam drum upto the individual soot blowers including all the pressure reducing station, valves and fittings.

Feed water delivery piping from steam generator feed pumps upto the economiser inlet header to the steam generating unit, via the HP feed water heater.

Piping for chemical dosing systems to be in SS.

All the drain points provided for various equipment shall be suitably piped and brought upto Purchaser's plant drain. The piping shall be provided with necessary fittings like trap, valves, etc.

The complete blowdown piping upto the drain trench including all valves fittings etc.

The blowdown lines from each blowdown valves of the steam generator shall be drawn individually upto the blowdown tank.

All pipe to pipe joints shall be by butt welding only and no couplings shall be used.

All flanges, when provided #300 class and above shall be weld neck type.

Pipe fittings like elbows, equal tees and reducers shall be as given below:

- a) Above 50 Nb shall be butt welded type.
- b) Less than or equal to 50 Nb shall be socket welded.

Branch connections :

- a) Socket welding half coupling, as per B16.11, for size Nb 40 and below.
- b) Welded branch connections with proper reinforcements for sizes above Nb 40.

All pressure tapping for pressure applications above 40 kg/sq.cm. shall be of size Nb 20 with two root valves. For pressures 40 kg/cm² and less the size shall be Nb 15 with one root valve.

All thermowell boss shall be one(1) inch NPT.

Pipe Sizing and Layout

The design of the piping system shall be based on the ANSI B31.1 code. In addition the statutory requirements Flexibility analysis shall be made for all piping systems with operating temperatures above 100°C. The correct locations of hangers and supports, with as applicable spring stiffness, shall be considered for the flexibility analysis. suitable expansion, loops, restraints and anchors shall be provided so as to ensure compliance with the applicable codes and to limit the stress and reactions to within the allowable values.

Drains at all low points and vents at all high points shall be provided.

All local instruments shall be located on pipelines so as to render them observable from the nearest available platform.

Hangers and supports

- The Bidder shall design, fabricate and furnish erection drawings for all hangers, anchors, guides, clamps, stops and supports, auxiliary structures, etc. required for the proper installation and support of the piping.
- It is desirable that supports should as far as practicable, be arranged adjacent to the pipe joint.
- Constant load hangers/ spring hangers shall be provided wherever necessary for critical piping systems such as main steam piping and steam generator feed delivery piping. The variation between hot and cold loads, if variable spring hangers are used, shall not exceed $\pm 25\%$ of the rated load.
- Lugs and additional structural members should be suitably welded to the pipes wherever necessary for hangers and restraints.

Valves

- All valves to be as per IBR 1950 with latest amendments
- All valves shall be suitable for the service conditions i.e. flow, temperature and pressure under which they are required to operate and those performing similar duties shall be interchangeable with one another unless otherwise approved.
- All gate valves shall be of the full way reduced bore type unless otherwise approved and when in the full open position the bore of the valve shall not be obstructed by any part of the gate. Reduced bore for valves 40 NB and below.
- Globe valves shall have preferable curved or spherical seating and the discs shall be free to revolve on the spindle.

- All non-return valves shall have an arrow cast or embossed on the side of the valve body to indicate the direction of the flow. For severe service conditions cushioned check valves are preferred to obviate valve clatter. In the case of swing - check valves the body seat shall be inclined at such an angle to the vertical as will facilitate closing and prevent clatter.
- The internal diameter of all valve ends to be connected to pipes shall be the same as the internal diameter of the pipe to which they are joined so as to minimise use of reducers/expanders.
- Where applicable valves shall be of the outside screw & yoke type.
- Main steam stop valve shall be fitted with indicators so that percentage of valve opening can be readily determined locally.
- Steam valves shall not be fitted in an inverted position. Eye bolts shall be provided wherever necessary to facilitate handling heavy valve or part of valves.
- Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation and to ensure that minimum of maintenance is required. For valves of size 2150 mm and above and the rating above 600 Psig, bevel spur gearing shall be provided to facilitate manual operation.
- All valves which require operation on regular basis for maintaining boiler efficiency and reliability will be motorised. Valves required for isolation or maintenance purposes will be manual. Motorised valves will include MSSV & its bypass, start-up vent, air vent, feed pump outlets, CBD & IBD, isolation valve before STG inlet, warm up vent valve. Pneumatic and motorised control valves will be provided in feed water control station, deaerator level & pressure control, soot blower pressure control, desuperheaters and all pressure control stations.
- All sampling and root valves furnished shall be of integral body bonnet type.

All the pressure parts such as tubes, coils, headers, drums, valves, cocks, gauge glass assembly, flanges, bends and pipes etc., shall be supplied with I.B.R. stamping. Items without I.B.R. stamping will be rejects.

Test (sample) cocks shall be provided to collect water/steam samples with necessary cooling arrangements in steam drum, superheated steam header etc.

Two 100% control valves (one pneumatic & one manual) of cast steel / alloy steel (located such its operator can see water level in gauge glass) capable of passing the required amount of water shall be provided.

The steam generator shall have two water gauge glass units (suitable for visibility and reliability) at the top drum independently connect on each side with isolating valves such that when one is to be attended, the other one will be in line. One remote water level indicator at the operating floor to be provided.

Appendix - III provides piping & welding procedure.

- **Ducting For Air and Flue Gas**

Necessary Mild steel ducting of 4 mm thk. plate in case of air duct and 6 mm thk in case of flue gas duct with stiffeners shall be provided. The minimum design pressure for the ducts will be 200 mm WC.

Necessary regulating and isolating dampers at suitable points are to be provided for the efficient operation and maintenance of the steam generator. All the dampers shall have an effective area not less than that specified for the ducts they control.

Suitable galleries and ladders with grating of open steel flooring for affording access to the essential levels of the steam generator plant complete with hand railing curb angles and supports shall be provided.

All supporting steel work hangers, thrust brackets and castings for the furnace shall be provided for steam generator.

The air and flue gas ductings shall be straight, with necessary long radius bends shall be provided. Sharp radius bends, divergings, convergings in ductings shall be avoided. All air and flue gas ductings shall be leak proof to avoid pressure losses and atmospheric air entry etc.

The details of air and flue gas velocity, draft and temperature at various points shall be provided.

All ducts shall be rectangular in cross section and will be of welded construction, properly stiffened and reinforced. All the air ducts, shall be fabricated from steel plates of minimum 5 mm thick, and all flue ducts shall be of minimum 6 mm thick. The duct plate material shall conform to IS 225/IS 2062 . The duct corners shall be stitch welded internally and full welded on the outside.

The ducts, exceeding 600 mm width or depth, shall be suitably stiffened and reinforced on the outside and designed to withstand the pressure encountered, but however the minimum design pressure for the ducts shall be ± 200 mm WC.

The internal struts wherever required for the ducts shall be of tubular (ERW) construction. The ducting system shall be complete with all required expansion joints, mating flanges, dampers, supports, access doors, platforms insulation's etc. The top of the ducts and /or the outer cladding shall be cambered to facilitate drainage of water.

The duct design consideration shall include the operating internal pressure, medium temperature, dead loads, ash loads, live loads, seismic loads, expansion joint reactions etc.

The ducting expansion joints are provided to take care of the duct expansions and shall be of sawtooth square corner type. The number of expansion joints required shall depend on the ducting thermal movement considerations. For the critical ducting sections, the Bidder shall provide the calculations for the flexibility analysis and the expansion bellows selection for approval.

Dampers, in the ducting system, shall be provided as called, for the proper operation of the steam generator. All dampers shall be of the 'louver' or butterfly type with the necessary frames, shafts, blades, bearings, linkages, seals, etc.

ID fan shall be located such a way to provide sufficient space to construct ID fan covers to protect the drive motors and bidder to install the hoist with monorail , if any ID fan drive motors shall be free from heat radiation, etc.

The steam generator shall be provided with a steel supporting structure from rolled steel sections and designed with adequate strength for load imposed by the steam generator. The steam generator shall be complete with necessary tubes, manifolds, integral pipe works.

All ducting etc. must be located above 2500 mm level to clear off the man and material movements.

All the steam gaskets as joints with a pressure of 7 kg/cm² (g) and above, shall be metallic grafted, high pressure steam gaskets suitable to twice the working pressure and temperature. Spare gaskets for all joints in HP steam line shall be supplied.

Adequate supports shall be provided for the roof tubes to avoid sagging of tubes in the hot conditions due to the weight of the refractory materials etc.

- **Foundation Bolts And Temporary Supports**

All foundation bolts & required templates for the same for main steam generator and all its auxiliaries in Bidder scope supply within the battery limits specified shall be supplied. The foundation bolts shall be adequate strength and made from suitable materials to take required loads torques, tensions, compressions to take require loads torques, tensions, compressions etc. to which they may be subjected to.

The necessary temporary support of steam generator pressure parts such as top (steam) drum, headers, steam generator tubes, superheater elements, and economiser shall be supplied by steam generator Bidder only.

- **Safety Valves**

The safety valves shall be semi nozzle full lift, and open bonnet type and the selection and sizing of the safety valves shall conform to the provisions of the IBR. In IBR and addition to meeting this requirements, the steam generator safety valves shall also meet the stipulations of ASME with regard to the blowdown and over pressure requirements. The

steam generator safety valves and all other safety valves shall be with butt welding end connection.

The valves shall be supplied with lifting level, test gag, cap and spring cover.

- **Control Stations**

All control stations shall be provided with a bypass with a manual regulating globe valve and isolating valves on either side of the control valve. The control valves shall be sized to have the maximum flow at a maximum of 90% of the valve opening. The noise levels at a distance of one meter from the control stations shall be less than 85 dB. All control stations shall be located in easily accessible areas with adequate space around for maintenance.

- **Insulation & Cladding**

Cladding for boiler roof will be metapoly / GI-coloured sheet, as approved by Purchaser. Insulation specifications are provided in *Appendix – VII*.

2.24 Steam Turbine Generator & Auxiliaries

2.24.1 Scope of Work

The STG and its auxiliaries including lube oil system, condenser, control panels, MCC and onward electrical, above ground earthing, ejectors will be supplied by purchaser. Bidder to provide main steam line upto turbine ESV, extraction line from extraction port upto distillery header, cooling water at condenser inlet and outlet flanges, auxiliary cooling water at inlet and outlet headers in power house including headers, compressed air at one point in power house, auxiliary steam from PRDSH to GSC and SJAE, condensate to deareator from condenser at outlet of condensate control station.

DCS system to be provided by bidder and below to be considered as required I/O's to the system.

2.24.1.1 Turbine Control System (*Provided by STG supplier*):

Axial shift and shaft vibration for high speed shall be monitored through VMS of TSP panel. The VMS shall be providing 4-20 mA signals for retransmission to DCS.

Provides turbine protection against rotor rotating frequency rise above the permissible limit.

2.24.1.2 Protection System (*Provided by STG supplier*):

Following protections are to be provided for turbine :

One no. electronic overspeed trip device (with 2 out of 3 voting) shall be provided in addition to Woodward 505 E governor (having 1 out of 2 sensors).

Low lubricating oil pressure

Increase of backpressure and condensing pressure

All other TG protections such as

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Page 138 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

- High / low control oil pressure
- High axial shift
- High shaft vibration for high speed.
- Low steam temperature
- High vacuum

Provision is made for the relay blocking the possibility to start-up turbine during shaft turning device being in operation and automatic start of start-up oil pump at turbine shutdown.

2.24.1.3 Local Panels (*Provided by STG supplier*):

- a) Local panel shall be supplied for the Turbo Generator set with suitable full size opening doors to provide access to all equipment.
- b) Turbine digital local guage board shall be provided to view the following important parameters.
 - Main steam inlet pressure/ temperature
 - Main oil header pressure
 - Control oil header pressure
 - Exhaust pressure / temperature
 - Turbine speed.

2.24.2 Controls & Turbine Control Panel (*Provided by STG supplier*):

2.24.2.1 Controls

All control signals will be supplied to the DCS for safe, efficient, start up, monitoring, control and shutdown operation of the steam Turbine. The minimum supervisory instruments to measure the following shall be provided, with provision of all signals to DCS: Speed, load, inlet & extraction steam pressures & temperatures, turbine wheel case pr., control fluid pressure, journal bearing metal temperature, thrust pad metal temperature, axial position of thrust collar relative to its own housing, shaft vibration, especially with a view to ensuring safety during starting operations and under transient conditions.

2.24.2.2 Control Panel (*Provided by STG supplier*):

Control Panel shall house the following:

- a. Electronic governor with keyed-in operating program for control of speed, load, inlet & exhaust pressures.
- b. Remote controls comprising of selector switches, ammeters, push buttons & indicating lamps for ;
 - i. AOP motor
 - ii. EOP motor
- d. Push buttons for turbine speed raise and lower
- e. Turbine remote trip/reset push buttons.
- f. Temperature scanner for Monitoring turbine and gearbox bearing temperature
- g. Alarm annunciator for Turbine fault monitoring.

The panel shall be complete with AC supply & DC supply on / off control switches, indicating lamps and space heater.

2.24.3 Lube Oil System (with connectivity to DCS system) (Provided by STG supplier):

- a) Level gauge in main oil tank
- b) PT 100 type duplex RTD's (one no per bearing) shall be provided for turbine + gear box and alternator bearing temperature monitoring.
- c) Alternator hot air and cold air temp gauge
- d) Alternator hot air and cold air temp RTD
- e) Alternator winding temp. 6 RTD
- f) AOP & EOP discharge pressure gauge
- g) Temperature gauge before filter
- h) Temperature gauge after filter
- i) Temperature element after filter
- j) DPT for lube oil filter
- k) Pressure transmitter control oil
- l) Pressure transmitter lube oil header pressure
- m) Pressure switch for lube oil pressure
- n) Lube oil pressure switch for auto start of auxiliary oil pump and emergency oil pump

2.24.4 Control Oil System (with connectivity to DCS system) (Provided by STG supplier):

- a) DPT across control oil filter
- b) Pressure gauge at CO header
- c) Pressure gauge on oil pr. Regulator
- d) Pressure transmitter for control oil pressure to ESV
- e) Pressure transmitter control oil pressure to CPC
- f) Pressure transmitter to trip device (safety block) -3 nos

2.24.5 Protection (with connectivity to DCS system) (Provided by STG supplier):

Turbine Protection with interlocks, trip logic & annunciation

- a) Over speed protection (high / very high)
- b) Governor emergency trip
- c) Axial shift protection, vibration high
- d) Lube oil pr - low
- e) Lube oil pressure too low
- f) Manual trip
- g) Remote trip
- h) Bearing temperature hi (turbine front / rear, thrust, gear box bearing, generator front journal)
- i) Live steam temp low
- j) Live steam temp hi
- k) Live steam pressure low
- l) Live steam pressure hi

- m) Generator / Electrical Faults : Differential fault
- n) Exhaust pressure & temp. - high
- o) Exhaust pressure & temp.- too high
- p) Control oil pr. – low trip and alarm
- q) Thrust wear high trip and alarm
- r) High vacuum
- s) High CEP level

2.25 AIR COMPRESSOR & DRYER

2.25.1 System Requirement

The purpose of this system is for supply of compressed air for control drives, control valves, pneumatic tools and miscellaneous control system and supply of plant air to the power plant. Service air needs will also be provided by this compressor. The system will provide a reliable supply of air that is free of water, oil or solid contaminants.

The compressors are to be opposed, belt pulley driven, non-lubricating type reciprocating air compressors complete with drive guards, AC electric motors, LPBS, air receiver, intercooler, after cooler, moisture separators, air dryer, moisture traps, all interconnecting pipe work & fittings, control panel, etc. The heat exchangers shall be designed as per TEMA-C and coolers shall be mounted horizontally. The air receiver shall be fabricated from SA 515 Gr. 70 or IS : 2002 material. The internal surface shall be galvanised.

Control air will be supplied to boiler and its auxiliaries, turbo generator and its auxiliaries and common plant auxiliaries like water treatment plant, fuel handling plant, ash, pump house etc. Compressed air will meet the requirements as stated below :

Capacity	: 150 m ³ /hr or higher as per plant needs
Nos.:	: 2 nos. (1 operating & 1 standby)
Pressure at receiver outlet	: 7 kg/cm ² (g)
Dew point temperature at atmospheric conditions	: (-) 40 ⁰ C
Particulate material size (max.)	: 1 micron
Contaminants	: No corrosive, hazardous, toxic Or flammable material
Oil Content	: 100% Oil Free

It is proposed to interconnect the service air system with the instrument air system before the instrument air dryers. A non-return valve and a manual isolating valve will be provided in this line so that instrument air cannot be supplied to the service air system.

2.25.2 Operational Requirements

It is envisaged that the air compressor, air receiver and air dryer will operate in series. However, the facility will be provided by suitable design / layout of the station air pipe-work, to operate each item in a sectionalised manner.

It is proposed to have common compressed air system meeting both instrument and service air requirement. With this approach compressed air after a common air receiver, a part of air will be directed to an air-drying plant and balance will serve the requirements of plant service air. The service air will be tapped off from up-stream of the air-drying unit. Air from air-drying plant will be directed to instrument air header, which will cater the requirements of instrument air for plant operation.

2.25.3 Other Technical Requirements

Each air compressor will include the following accessories

- a) Silencer and filter for air intake
- b) Inter cooler for multi-stage compressor complete with trap station with bypass arrangement.
- c) After cooler complete with trap station with bypass arrangement
- d) Air receiver of 2 m³ (water volume) or higher capacity to hold air and minimize pressure fluctuations.
- e) Instrumentation to monitor and control the whole compressed air system including pressure gauge, pressure transmitter, temperature gauge and temperature transmitter.
- f) All pipes will be ERW heavy duty, C class, GI or aluminium
- g) Interconnecting valves, safety valves, NRV's and piping.
- h) All valves for air will be ball valves with Teflon seating. All valves for water to be ball valves designed for 5 kg/cm²(g) pressure.
- i) Automatic moisture traps at both compressors and at receiver.
- j) Water for cooling to be provided at 1.5 kg/cm²(g) to 2.5 kg/cm²(g)
- k) Cooling water to be available at 32⁰C

Air compressor package shall be skid mounted with inter and after cooler, receiver, dryer, automatic control and monitoring system. The compressor piping shall be galvanized. The heat exchangers shall be as per TEMA C standards for heat exchanger, cooling water flow through tubes. Heat exchanger tubes shall be of copper and carbon steel surfaces susceptible to corrosion shall be hot dip galvanized. The shell material of moisture separator, after cooler shall be of IS 2002 Gr. 2. The electric motor shall be as per IS 325 and compressor is driven through flat belt-pulley. Electric motor shall be of IP 54 enclosure. All interconnecting piping shall be galvanized.

2.25.4 Air Drying Plant

One no. heatless type air drying plant of 150 m³/hr capacity or as per compressor capacity with 2 nos. drying towers with Activated Alumina as desiccant will be installed at compressor outlet for producing moisture free air of instrument air quality. Re-generation shall be done using purge air. The material of absorber tower shall be of IS 2002 Gr. 2. The maximum air pressure drop shall be limited to 0.3 kg/cm². The air dryer plant outlet air pressure shall be 7.0 kg/cm²g and the maximum air temperature shall be 40⁰C. The mechanical design pressure of air drying plant shall be 10.5 kg/cm² (g).

2.25.5 Air Receivers

The receiver will be self-supporting cylindrical vessel. The receivers will be so sized that in the event of a compressor failure, the receiver pressure will not fall from the normal working pressure of 7 kg/cm² (g) to 4 kg/cm² (g) in less than 5 minutes time. The air receiver shall be designed as per IS 2825. Material of construction shall be IS 2002 Gr. 2 and the design pressure shall be 10.5 kg/cm²(g). Minimum capacity of the receiver will be 2 m³.

2.26 Fuel & Ash Handling System

Bagasse Handling System

- 1 No main bagasse carrier to feed bagasse to boiler & feed excess bagasse to Return Bagasse Carrier.
- 1 No Return Bagasse Carrier to feed bagasse from yard to Main bagasse Carrier and to carry excess bagasse to yard.
- The drive assembly shall include the gearbox, coupling, common base frame, guards, electric motors, local push button stations etc.

The technical parameters of above conveyors are tabulated below:

Parameters like C/c distance, height are indicative only & shall be suitable for selected boiler dimensions.

Sr. no	Description	MBC-1	RBC-2
1	Capacity TPH	4	4
2	Material	Bagasse	Bagasse
3	Bulk Density Kg/M ³	150	150
4	C/c Distance Mtr	15	50
5	Lift Mtr.	0	25
6	Angle of Inclination	0	45 deg. max
7	No of feed points	1	Through out the feeding length
8	No of discharge points	5 (To be decided by vendor)	1
9	Type of conveyor	Chain	Chain
10	Conveyor Width mm	800	800
11	Hood Cover	Required for Entire Length	

Coal Handling System

Coal will be fed to coal hopper by pay loaders & conveyed to coal crusher through conveyor no CC-1. Crushed coal will be conveyed to Coal Bunker through Bucket Elevator BE-2 & drag chain conveyor DCC-3.

Over-band type magnetic separator mounted on conveyor no CC-1 to separate ferrous material from coal & only coal will be fed to crusher.

- 1 No grizzly hopper for coal of 3.0 MT capacity with 2000 x 2000 mm top opening & 150 X150 mm grizzly
- 1 No electro-magnetic type-vibrating feeder of 4 TPH capacity
- 1 No belt conveyor (CC-1) of 650 mm wide x 40 Mtr. C/C
- 1 No Over- band type magnetic separator suitable for 650 mm belt width
- 1 No crusher of 4 TPH capacity to crush ROM Coal to either (-) 20 mm or size as per boiler requirement
- 1 No bucket elevator BE-2 of 4 TPH capacity X 25 Mtr Height
- 1 no crusher house in M S construction
- 1 No Chain conveyor (DCC-3) of 650 mm wide x 21 Mtr. C/C

The technical parameters of above conveyors are tabulated below:

Sr. No	Description	CC-1	BE-2	DCC-3
1	Capacity in TPH*	4	4	4
2	Material	ROM Coal	Crushed Coal	
3	Bulk Density Kg/ cm ³	600	600	600
4	C/ c distance Mtr	40	25	21
5	Elevation at feed point M	(-)2.5	1	22
6	Elevation at discharge point M	5.0	26	20
7	Lift Mtrs (Indicative)	7.5	25	0
8	Type of Conveyor	Belt	Belt	Chain
9	Type of take up	Screw	Screw	Screw
10	Conveyor Width mm	650	500	500
11	Walkway	Required on both sides for conveyor no CC-1		
13	Hood Cover & side sealing	Required for conveyor no CC-1		

- Dust extraction system comprising of pulse jet bag filter, centrifugal fan along with Motor, ducting, hoods to ensure that the out let dust emission is below 50 mg/nm³ along with air compressor & piping in crusher house & coal bunker.
- System / distances indicated above are indicative only. Offered system should be capable to feed coal to slop fired boiler from yard as shown in the layout.
- Capacity mentioned is considering 12 Hrs of operation for 2.0 TPH requirement of coal for boiler. Bidder to confirm and offer as per coal requirement for their boiler, whichever is higher.

ASH HANDLING SYSTEM:

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HBL/TEN/PUB/20-21/223 dated 06.02.2021

Page 144 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

BED ASH HANDLING SYSTEM

- Submerged ash belt conveyor with trough of 1000mm width and C/c distance suitable to take bed ash to a ash trolley located beyond boiler columns. This conveyor has to be mounted in a MS trough; the belt should be submerged in water with a level of minimum 250 mm.

FLY ASH HANDLING SYSTEM

- Water jacketed screw Conveyors/ slat conveyors below each ash discharge points, of 400 mm dia /500 mm width X suitable length as per boiler dimensions.. MOC of conveyors shall be min SS304 or to be suitable for ash temperature discharged through boiler
- Cross conveyors, slat type, to convey ash, (for ash discharge points below economizer and ESP and for other ash discharge points) to common conveyor.
- Common conveyor to collect ash from all above conveyors to ash silo.
- 1 number of Ash Silo of 50 M³ capacity with the supporting structure and sector type discharge gate of minimum 350 NB size

The technical parameters of above conveyors are tabulated below:

Sr. No	Description	Screw Conveyors /Slat conveyors below ash generating point	Slat conveyor to collect ash from other ash hoppers to ash silo	Slat conveyor to collect ash from economizer and ESP hoppers to ash silo
1	Capacity TPH	4.0	4.0	4.0
3	C/C distance, m	As per boiler dimensions		
4	Lift, m	0	As required	As required
5	Angle of Inclination	0	30 ⁰	30 ⁰
6	Type of Conveyor	Screw/slat	Slat	Slat
7	MOC	Minimum SS304 or to be suitable for ash temperature discharged through boiler		
8	Width/ Diameter of the conveyor	400 /500 mm	500 mm	500 mm
9	One side Walkways	NA	Required for partial length	Required for partial length

SYSTEM / DISTANCES INDICATED ABOVE ARE INDICATIVE ONLY. OFFERED SYSTEM SHOULD BE CAPABLE TO FEED ASH FROM ALL ASH GENERATING POINTS TO SILO.

Electrical

All AC motors required for the conveyors. The motor terminal box shall be complete with cable gland & lugs.

Starters lockable push button stations MCCs, all cabling including galvanized cable trays, equipment /body earthing etc.

Lightning protection for the structures, as required with necessary vertical /horizontal conductors, each earth electrodes & connection to earth pit.

Instrumentation & Controls

Safety switches for the system including zero speed, pull chord at a spacing of 30 Meters. on both sides, belt sway switches at a spacing of 60 Meters, emergency switches, as applicable.

Control System including control panel for the sequential operation with inter phase facility to communication with the boiler control system.

Local instruments including switches, instrument cables, terminal boxes, cable trays & accessories, as required to make the system complete.

Required fire fighting system for fuel handling will be provided.

Civil:

Civil load data & inputs, Supply of all embedment, foundation bolts, fasteners, shim plates & grouting material, etc, as required for the equipment foundation.

General:

- Interconnecting chutes, hoods over conveyors supporting structures, maintenance Platforms, approach, etc as required
- Any other item not specifically mentioned above but required for satisfactory performance of the fuel and ash handling system
- Consumable materials as required for erection & commissioning including electrodes. First fill lubricants, flushing oil, etc.
- Commission spares & two year operating spares.
- One set special tools & tackles required for operation & maintenance inspection & repair of equipment supplied.
- Two coats of primer, one coat of finished paint & final painting at site.
- Performance Test.

Design Basis

The fuel & ash handling system covered under this specification shall be designed to achieve the

Signature and Seal of the Bidder **HBL/TEN/PUB/20-21/223 dated 06.02.2021** **Page 146 | 278**

(COMMERCIAL & TECHNICAL UNPRICE BID)

following objectives.

Performance parameter

The performance parameters are as follows.

Material Handling System

1	Material Handled	Ash from Boiler bed, Economiser, ESP and other Hoppers of Boiler & Baggase and coal from yard.
2	Bulk Density	Coal Ash : 600 Kg/Cu M, Bagasse ash 160-180 Kg/Cu M Coal : 600 Kg/Cu M, Bagasse 160 Kg/Cu M
3	Material Temperature	40 Deg .C for Coal. Temperature of ash at various points shall be as per boiler outlet ash temperature.

Detailed Technical Specifications

A) Belt Conveyor

The length of the conveyors is indicated in the scope of work are drive pulley centre to discharge pulley centre (c-c) distance & they are approximate. The exact length and lift of the conveyor shall be determined by the Contractor based on the design parameters indicated and taking into consideration the dimensions and arrangement of the equipment offered by the Contractor.

The carrying capacity indicated are the rates at which the equipment shall be guaranteed to operate continuously. The angle of inclination of conveyor belts shall not exceed 18 deg to the horizontal for standard belt. For inclination up to 30⁰cleated type belt shall be provided. The belt conveyors and accessories shall be suitable for continuous operation under severe duty working condition. Design & construction feature of the belt conveyor shall be in accordance with IS: 11592.

The scope of supply shall include but not limited to the belting, idlers, (carrying, return, impact, SACI & SCRI), pulleys including head, tail/ take up, snub, bend., belt internal/ external cleaners, take up units, drive unit complete with electric motors, reduction gear boxes, flexible coupling, for both high speed and low speed sides, base frames, integral hold back device, electric safety switches, auxiliaries like skirt board, deck plates, dust seals, coupling guards, take up guards etc., structural item like stringers, short supports, take up frames, conveyor gallery, walkway, conveyor support columns and frames, hoods and all other accessories that may be necessary to make each conveyor and the system complete.

The belt shall be of Nylon- Nylon type with suitable top and bottom cover. The number of plies and weight of duck shall be suitably selected with due regard to load/flexibility of troughing. Hot vulcanising shall be considered for the joints.

The idlers shall be made of seamless /ERW steel tubes. The idler rollers shall be fitted with deep groove ball bearings.

Troughed idlers shall be concentric and shall have 3 rolls, 20 deg. Troughing angle. All bearings shall be designed for a minimum life of 40000 working hours. The return idlers shall be single roller flat type and covered with rubber sleeve wherever required. Impact idlers shall be provided at the loading each loading point. The roller assemblies shall be designed to prevent dust accumulation.

The spacing for the troughing and return idler shall be as per IS 11592. Shorter spacing shall be considered for the bends and for reasons of heavy loading. The impact idlers spacing shall not be more than 300 mm. Self aligning carrier and return idlers shall not be more than 20 Meters apart and more than 15 meters from each terminal.

The conveyor pulley shall be welded steel construction with closed ends. The pulley diameter shall be designed for maximum belt life and confirm to IS specification. The entire assembly of the pulleys shall be balanced and grooved rubber lagging shall be provided for the drive pulleys.

The take-up shall be vertical gravity type for the inclined conveyors and screw type for short conveyors up to 30 Mt. length. The unit shall be complete with counter weights, take-up pulleys and structural frame to make the installation complete.

Skirt board shall be provided at loading zones and in other places to prevent spillage. The skirt plate thickness shall be minimum 6 mm and the rubber strip thickness shall be minimum 10 mm. The deck plates shall be 2.0 mm for the entire length of the belting.

The belt conveyor shall be complete with coupling guards, discharge / feed hoods, pulley guards drives supporting structure, maintenance platforms and drive platform shall have adequate space on both sides to attend to drive unit.

All conveyors shall have removable type hinged hoods with industrial hinged & painting. The hood shall be fabricated from minimum 1.6 mm thick M S sheets with suitable stiffeners & clamping arrangement & shall be provided for all conveyors in open portion.

B) Chain & Slat Conveyor

The length of the conveyors is indicated in the drawing are from drive sprocket centre to discharge sprocket centre (c-c) distance & they are approximate. The exact length and lift of the conveyor shall be determined based on the design parameters indicated and taking into consideration the dimensions and arrangement of the equipment offered.

The carrying capacity indicated are the rates at which the equipment shall be guaranteed to operate continuously. The angle of inclination shall not exceed 45deg to the horizontal. The slat conveyor and accessories shall be suitable for continuous operation under severe duty working condition. Design & construction feature of the slat conveyor shall be in accordance with relevant I S Standard.

The chain conveyor shall be of all steel construction suitable for outdoor duty and for the specified conveying capacity. The linear speed of the conveyor shall not be more than 25 M/Min.

The scope of supply shall include but not limited to the chain, sprocket, slat with cleaning arrangement, take up units, drive unit complete with electric motors, reduction gear boxes, flexible coupling, for both high speed and low speed sides, base frames, integral hold back device, electric safety switches, auxiliaries like deck plates, dust seals, coupling guards, take up guards etc., structural item like short supports, take up frames, conveyor gallery, walkway, conveyor support columns and frames, hooks and all other accessories that may be necessary to make each conveyor and the system complete.

The chain shall be of forged steel with suitable attachment for mounting the slats. The chain shall be supported on the suitable guides. The minimum factor of safety for chain design should be 10.

The braking strength of chain shall be minimum 30,000 Kgs.

The slats should be made up of SS 304 & the minimum thickness shall be 6 mm.

The sprocket shall be of cast steel with machine cut teeth & the diameter shall be designed for maximum chain life and conform to IS specification.

Suitable take up shall be provided. The arrangement drawing should be furnished with the offer.

The slat conveyor shall be complete with coupling guards, discharge/ feed chutes, coupling guards, drives supporting structure, maintenance platforms and drive platform & shall have adequate space on both sides to attend to drive unit.

C) Screw Conveyor

The screw conveyor assembly shall include the screw flight, pipe shaft, trough, trough cover, water jackets end cover, bearings, hanger bearings, end shaft, trough end seals, saddles, inlet & outlet spouts, drive unit complete with electric motors, reduction gear box, couplings for both high speed sides, weather hood for drive box, structural items like short supports, drive platform, approach and all other accessories that may be necessary to make the conveyor complete. All ash contact parts shall be in SS 304 construction.

The screw flight shall be of 6mm thickness (minimum).

The trough & trough end cover thickness shall be minimum 6 mm & 12 mm thickness respectively.

Provision for thermal expansion shall be provided if the outlet flange of discharge point is directly connected to the screw conveyors. Necessary expansion bellows are in the Contractors scope.

Hard facing of the screw flight shall be out on the carrying side for 1" face width (minimum)

Packed gland seal shall be provided at tail or drive shaft opening in the trough ends to prevent material leakage.

Pitch of the screw shall be 0.8 to 1 D where 'D' is the diameter of the screw. However, to meet the required capacity, the pitch may be maintained short, half or long.

D) Chutes

All the conveyors shall be provided with discharge /receiving chutes for the flow of material. The chutes shall be fabricated from minimum 6 mm thick M S plates. Whenever required suitable liner plates shall be provided to withstand the erosion due to falling material. The liner plates shall be bolted to the main plate. Feed & discharge chutes shall be provided from conveyor to conveyor.

Sufficient number of pock holes & access door shall be provided in long chutes.

E) Vibrating Feeder

The vibrating feeder shall be electro mechanical type with suspended spring mounting . it shall be designed for a maximum coal lump size of 212mm

The vibrating motion to be provided with two heavy duty, synchronized, counter rotating electro mechanical vibrator motors. The motors shaft shall be heavy duty type with adjustable unbalance weights mounted on each side. The frequency of vibration shall be around 3000vibrations /min.

The vibrating feeder pan construction shall be of wear and impact resistant steel with replaceable lining

F) Crushers

The crusher should be capable of handling coal of lump size 0-212 mm with maximum 25% moisture.

The product size of the coal shall be less than (-) 20 mm or as per boiler requirement. Crusher shall be designed for continuous heavy duty operation in dusty environment generally prevalent in plant operation. the crusher should be complete with lubrication system .

The frame should be fabricated of heavy steel plates and ribbed for additional strength. Abrasion resistance manganese or chrome steel plates (renewable) shall be bolted to the main body to take care of erosion. The body shall be provided with inspection doors in the front & rear side and are fitted with dust tight seals.

The rotor shaft shall be made of forged carbon steel & properly balance to minimize vibrations. Extra heavy duty bearings with minimum life of 25000 hrs shall be used. Labryinth seals shall be provided for bearings.

Wear resistance steel blow bars shall be fixed to rotor body & clamped with locked nut/ cams & wedges.

Breaker plate shall be made out of wear resistance steel & to be fixed to break plates stocks by special forged high tensile bolts.

Tramp Iron trap of heavy deflector plate shall be provided to prevent tramp iron/ Un crushable from continuing around & back into the crushing cycle.

A suitable heavy duty drive unit shall be considered for crusher.

G) Dust Extraction System

The air volume for the dust extraction system shall be calculated as per the norms given in ACIGH standard.

The bag filter shall be reverse flow pulse jet type. The bags shall be of polyester needle felt with antistatic treatment. The bag weight shall be minimum 500 g/m².

The bag filter casing design pressure shall be minimum +/-500 mm WC.

The bag filter shall be complete with casing, hopper, pulse valves, solid state sequential timer. Bag cleaning shall be on line.

Bag Filter shall be provided with motorized rotary air lock valve.

Centrifugal fan for the dust extraction system shall be designed with 10 % excess volume & with minimum 80 % static efficiency. The fan speed shall not exceed 1500 RPM.

H) Supporting Structure

The complete supporting structure required for the Fuel and ash handling system will form part of scope of supply. The complete structural work above finished floor shall be of steel

I) Ash Silo

Silo shall be designed for storing the quantity of ash generated at various points and the capacity shall be minimum 50 M3. The silo shall be of MS construction and the conical portion of the silo shall be lined with TISCERAL/ SISCERAL liner of 5 mm thick. Sufficient headroom & side clearance shall be provided below the silos for bulk tankers/ trucks movement.

J) Discharge Gates/ Chutes

Manually operated discharge / diverter gates shall be provided whenever required to facilitate flexibility of operation and maintenance of the system. The gate shall be fabricated from minimum 10 mm thick M S plates. The gate shall be provided with antifricition bearings with suitable seal for free movement. The gate shall be of rack & pinion type.

All the conveyors shall be provided with discharge /receiving chutes for the flow of material.

The chutes shall be fabricated minimum 6 mm MS plates with suitable liner plates shall be provided to withstand the erosion due to falling material.

K) Discharge Hood & Chutes

All the conveyors shall be provided with discharge/receiving chutes for the flow of material. Also the discharge chute shall be designed to cover the belt scrappers at the bottom of the belt. The chutes shall be fabricated from minimum of 6mm MS plates.

Wear & abrasion resistant (ultra high molecular weight polymer) liner should be provided on material sliding surface. The liner shall be fixed to MS plate by mechanical fasteners or welded washer system and discharge chutes shall be provided from conveyor to conveyor.

Properly designed discharge for effective de-dusting and dust tight flexible rubber access door (min 400sq.mm) shall be provided the height of the discharge hood shall be 1500 mm from the belt top. Deflectors shall be provided in discharge hoods wherever the belt conveyors are discharging at 90 degrees.

The back end of discharge chute and return belt shall be properly sealed by replaceable rubber strip to avoid dust nuisance.

Sufficient number of poke holes (min 100NB pipe) and access door (min400sq.mm) to be provided in long chutes with access platform and staircase.

L) Junction towers

All junction towers shall have maintenance platforms, landings, hand rails & toe plates, side sheeting, top sheeting. All floors & landings shall be provided with minimum 2500 mm clear head room.

Instrumentation

The material handling system will be controlled by the DCS. The interlocks will also be provided in the MCC. The ash handing system will have all the primary sensors that are required for the sequential /safe operation of the system offered. All field wiring from the sensors will be terminated suitably in a terminal box.

Specific Requirements for the System Components

The reduction gear box used shall be of helical type completely enclosed with flash lubrication. The gear box shall be rated 24 hours continuous working with a minimum service factor of 2.0 on the installed motor capacity.

The couplings provided shall be of flexible type and shall have a minimum service factor of 2 on the installed motor capacity.

All bearings shall be preferably anti friction type and self aligning in nature The bearings shall have

effective and dust covered. The bearing shall be selected for a minimum working life of 40000 hours Effective lubrication shall be provided for all bearings and sliding surfaces .

All the structural steel used shall meet the requirements of IS: 2062 and the Steel plates used shall not be less than 5mm thick.

A minimum walking /maintenance space of 750 mm on both sides shall be provided for the entire length of the conveyors. The walkway shall be complete with hand railing, approach ladders etc.

All the conveyors outside the building shall be covered by removable type hoods .The hoods shall be fabricated from minimum 2 mm thick by MS sheets/ Meta-poly sheets with suitable stiffeners and clamping arrangement.

All sprockets in the drive unit shall be of cast steel with machine cut teeth. The shaft shall be of EN8.

2.27 Cooling Tower, CW pumps and CW piping

2.27.1 Scope of supply and services of basic equipment

This section details out the scope of supply and services for package cooling tower with auxiliaries as indicated

All materials supplied under this contract shall be new and unused.

Scope of supply of cooling tower

- a. One cell, cooling tower, 1000 m³/hr capacity with RCC basin.
- b. Recovery stack
- c. All supporting structures
- d. Entire fills and support
- e. Drift eliminators
- f. Ladders for easy accessibility to fan deck
- g. Fans, gearbox, motor, vibration and oil level limiters / indicators / alarms and control
- h. All associated instrumentation
- i. Required partitions, supports, etc.
- j. Following digital / analog requirements to be given.
 - i Level indication and alarm for low level: for water in the cooling tower basin. Vibration alarm for the fan assembly.
 - ii Low oil level indicator switch with transmitter to be provided for each Fan Gear Box.

The bidder further guarantees the following:

The total pumping head required (including static height and losses in pipes and distribution system) with respect to normal water level in the basin at Contractor's terminal point shall not exceed 15 MWC at design flow.

The hot water returning from the auxiliaries is cooled in the cooling tower, designed for a cooling range of 8 Deg. C and an approach of 5 Deg. C while operating under the atmospheric wet bulb temperature of about 28 Deg. C. The cooling tower shall be of pultruded FRP construction.

All hardware will be SS 304.

PVC film type fills to be used. All pultruded sections will be 5 to 7 mm and panels will be minimum 3 mm. All walls will be of fire retardant FRP. All nozzles will be self flushing. There will be two cells.

Required instrumentation connected to DCS for vibration switches, inlet and outlet temperature, CW pressure will be provided.

The structure shall be designed for wind and other loads as per IS:875 and earthquake resistance as per IS:1893. The cooling tower shall be carefully designed such that there is no re-entrainment of the vapours.

2.27.2 RCC Basin

Concrete cooling tower basin of about 10 minutes capacity with a common outlet channel shall be constructed by the purchaser as per drawing. The structure shall be designed as per IS:3370. Cooling tower basin shall be provided with partition for isolation purposes basin shall be water tight without the use of any fillers, paints or sealing compounds.

The blowdown system should be constructed in the RCC basin with all the necessary isolation compartments, isolation valves/control valves, as per the standard practices and good engineering practice for each cell to enable controlling the blowdown cycle of CT basin water. Drain pipes should have valves and lead to the common drain. All hardware and valves to be provided by bidder.

2.27.3 CW Pumps

- 2 x 100%, CW pumps, each of 900 m³/hr, 30 m head with VFD drive.

2.27.4 CW Piping

- MCW piping from MCW pumps to turbine condenser and return with required expansion bellows, inlet and outlet branches, pressure gauges, supports etc. Distance of cooling tower to power house will be about 40 m. For any underground piping required earth protection covering or tar felt mats to be provided and all piping to rest on RCC stools. If above ground piping is provided, all supports will be in bidders scope. All piping will have two coats of anti corrosive painting and required coats of final painting as per colour code.
- ACW piping from MCW piping to ACW supply & return headers and return to cooling tower, including the headers. Headers to be sized for 150 m³/hr flow with inlet valve for 150 m³ and 3 outlet valves each for 60 m³/hr. Distance of cooling tower to headers will be about 50 m. For any underground piping required earth protection covering or tar felt mats to be provided and all

piping to rest on RCC stools. If above ground piping is provided, all supports will be in bidders scope. All piping will have two coats of anti corrosive painting and required coats of final painting as per colour code.

- CW piping from cooling tower forebay to be provided with NRV, strainers pressure gauges, globe valves and NRV in delivery, air vent valves, pressure gauges, NRV, expansion bellows before and after condenser.

2.27.5 Materials of Construction

All materials of construction shall be of tested quality. These shall be free from defects, imperfections, of latest manufacture and shall be of certified quality for physical and chemical properties. Materials shall be of IS, ASTM, BS or any equivalent standard.

2.27.6 Tests and Inspection

a. Performance Test

Field erected units after complete erection and commissioning shall be field tested for performance. The test shall be conducted a time when the atmosphere conditions correspond to as soon as possible the design conditions. The test shall be conducted in accordance with the standard procedure for acceptance test of 'Cooling Tower Institute' USA.

The performance of the cooling tower shall be guaranteed over the following ranges:

- a) Cooling water flow 90% to 110% of design flow
- b) Cooling range 80% to 120% of design range
- c) Wet bulb temp (+) 1.7⁰C to (-) 3.9⁰C of design inlet wet bulb temperature.

Tests shall be conducted at the works on the fans, gear reducers drives etc., for satisfactory performance. Tests certificates for these shall submitted for Purchaser's approval.

Bidder shall include in his bid for the supply and maintenance of all instruments for the duration of tests period.

For the measurement of flow, during testing of cooling towers, Bidder shall supply pitot tubes (calibrated) for each of the risers for each tower.

Dry bulb and wet bulb temperature shall be measured by three identical mechanically aspirated psychrometers or Vick type located at three equidistant stations near each tower. The above thermometer shall be with graduations not exceeding 0.1⁰C. All water temperature shall be measured with mercury in glass thermometers with 0.1⁰C graduations.

The wind velocity shall be measured by means of anemometer.

2.28 PIPING AND FITTINGS

2.28.1 Piping

All plant piping will be as per applicable IBR / ASME standards. All piping will be aesthetically and neatly laid on pipe racks with approved colour coding. The plant piping will inter-alia include raw water intake from the existing WTP area, DM water piping from existing DM transfer pumps to deareator, cooling water circulation, plant service water, plant potable water, compressed air ring, drain piping, steam piping from boiler to turbine, steam piping from HP line via PRDSH stations to process line, MP steam piping to all turbine auxiliaries, steam piping upto header in distillery.

HP piping to be sized for highest safety valve pressure at 110% MCR with maximum pressure drop of 2 kg/cm² for the entire piping. The pipeline will be duly approved by IBR by the Bidder on the buyers behalf. Standard fittings like expansion loops, stream traps, supports etc. are to be provided. The line should insulated to suit weather conditions and preferably of ceramic blanket with mineral wool and aluminium cladding (22 g), to achieve skin temperature of not higher than 65°C. Stress analysis for the HP piping to be submitted by the Bidder along with IBR approved steam pipe drawing.

Piping design will be as per ASME B 31.1. All piping required for effectively connecting the steam generator with the steam, feed water, and other systems shall be provided. The piping provided shall be complete in all respects including valves, fittings, supports etc. as required. Necessary supporting materials, towers and trestles to support and anchor the pipelines at regular intervals shall be supplied. Suitable expansion loops and hangers shall be provided wherever necessary.

The correct locations of hangers and supports, with as applicable spring stiffness, shall be considered for the flexibility analysis.

Suitable expansion loops restraints and anchors shall be provided so as to ensure compliance with the applicable codes and to limit the stress and reactions to within the allowable values.

- i) Drains at all low points and vents at all high point shall be provided.
- ii) All local instruments shall be located on pipelines so as to render them observable from the nearest available platform.
- iii) Oil drains shall be sized to run no more than half full when flowing at a velocity of 0.3 m / sec, and shall be arranged to ensure good drainage.

All high pressure drain or vent valves or other valves to be provided with one control & one isolating valve set, to prevent any passing of the operating valve.

All pipe to pipe joints shall be by butt welding only and no couplings shall be used.

All flanges, when provided #300 class and above shall be weld neck type.

Pipe fittings like elbows, equal tees and reducers shall be as given below:

- a) For pipe size 50 NB and above shall be butt welded type.
- b) For 40 NB and below shall be socket welded type.

Branch connections:

- a) Socket welding half coupling, as per B16.11, for size NB 40 and below.
- b) Welded branch connections with proper reinforcements for sizes above NB 40.

All pressure tapping for pressure applications above 40 kg/sq. cm. shall be of size NB 20 with two root valves. For pressures 40 kg/cm² and less the size shall be NB 15 with one root valve.

All thermo-well boss shall be one(1) inch NPT.

The design of the piping system shall be based on the ANSI B37.1 code. In addition the statutory requirements Flexibility analysis shall be made for all piping systems with operating temperatures above 100°C. The correct locations of hangers and supports, with as applicable spring stiffness, shall be considered for the flexibility analysis. suitable expansion, loops, restraints and anchors shall be provided so as to ensure compliance with the applicable codes and to limit the stress and reactions to within the allowable values.

Drains at all low points and vents at all high points shall be provided.

All local instruments shall be located on pipelines so as to render them observable from the nearest available platform.

Flow quantities for the design of the piping connected with PRDSH.

1. **40 / 5 ata Deaerator steam start up or provide PRDSH from primary super heater**

- Pressure (Ata) @ down stream of PRDS	As required for deareator
- Temperature (°C) @ down stream of PRDS	150
Quantity Requirements	
- Minimum (Kg/Hr)	100
- Normal (Kg/Hr)	250
- Maximum (Kg/Hr)	500

2. **40 / 4.5 ata Process steam PRDSH 1**

- Pressure (Ata) @ down stream of PRDS	4.5
- Temperature (°C) @ down stream of PRDS	160
Quantity Requirements	
- Minimum (Kg/Hr)	2000
- Normal (Kg/Hr)	16000
- Maximum (Kg/Hr)	18000

3. **40 / 11 ata STG auxiliary steam PRDSH 2**

- Pressure (Ata) @ down stream of PRDS	11
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- Temperature (°C) @ down stream of PRDS	250
Quantity Requirements	
- Minimum (Kg/Hr)	250
- Normal (Kg/Hr)	300
- Maximum (Kg/Hr)	700

2.28.2 Piping Synopsis of Steam generator

Complete soot blower piping from the tap off on the primary superheater header up to the individual soot blowers including all the pressure reducing station, valves and fittings.

Feed water delivery piping from steam generator feed pumps up to the economiser inlet header to the steam generating unit, via the HP feed water heater.

Feed water line from feed water transfer pump outlet to the de-aerator.

Piping for high pressure and low pressure chemical dosing systems.

All the drain points provided for various equipment shall be suitably piped and brought up to plant drain. The piping shall be provided with necessary fittings like trap, valves, etc.

The complete blow down piping up to the drain trench including all valves fittings etc.

The blow down lines from each blow down valves of the steam generator shall be drawn individually up to the blow down tank.

Cooling water piping wherever necessary.

The steam generator integral piping consists of all the interconnecting piping between the economiser inlet stop valve and the super-heater outlet header. The number of size and the arrangement of these integral piping shall be based on the permissible pressure drops in these pipes and the distribution required in the respective headers of the various sections of the steam generator. These piping shall be properly supported and provided with the required tapping, stubs and thermo wells for measurements.

Test (sample) valves shall be provided to collect water/steam samples with necessary cooling arrangements in steam drum, mud drum, superheated steam header etc.

Two control valves (pneumatic and motorised) of cast steel/alloy steel (located such its operator can see water level in gauge glass) capable of passing the required amount of water shall be provided.

The steam generator shall have two water gauge glass units (suitable for visibility and reliability) at the top drum independently connect on each side with isolating valves such that when one is to be attended, the other one will be in line. One remote water level indicator at the operating floor to be provided.

2.28.3 Piping synopsis for turbine

All piping required for effectively connecting the turbine with the subsystem shall be provided. The piping will be supplied in pre-fabricated condition.

The piping provided shall be complete in all respects including valves, fittings, supports, blow off line etc. as required.

2.28.4 Piping synopsis for Compressed Air, Effluent

All compressed air piping for service and instrument needs from compressed air receiver within the power plant will need to be carried out. All compressed air piping will be above ground and required drains and filters will be provided.

All liquid effluent from all drains, blow down, ash system, etc. will be led through below ground drains or CI / RCC pipes to the existing ash sludge pits, near boiler.

2.28.5 Yard Piping

Estimated lengths for yard piping is given below. The same is to be considered for bidding purposes. Actual length will vary as per final layout and bidder to provide unit rates.

Utility	Estimated piping distance, m
MP steam to distillery	200
Condensate from process	100
Raw Water from existing WTP area	500
DM Water Piping from existing pumps	500
Compressed air	All required piping within scope and at one point in power house sized for 8 scfm.
Main steam piping upto STG	As per final layout, estimated distance to be about 80 m.
Cooling water piping for condenser	40m distance each way.
Cooling water piping for turbine auxiliaries	50m distance each way.

2.28.6 Hangers and supports

The Bidder shall design, fabricate and furnish erection drawings for all hangers, anchors, guides, clamps, stops and supports, auxiliary structures, etc. required for the proper installation and support of the piping.

It is desirable that supports should as far as practicable, be arranged adjacent to the pipe joint.

Constant load hangers/ spring hangers shall be provided wherever necessary for critical piping systems such as main steam piping and steam generator feed delivery piping. The variation between hot and cold loads, if variable spring hangers are used, shall not exceed $\pm 25\%$ of the rated load.

Lugs and additional structural members should be suitably welded to the pipes wherever necessary for hangers and restraints.

2.28.7 Valves

All HP valves to be 1500 Class (or as per IBR) and glandless

All valves shall be suitable for the service conditions i.e., flow, temperature and pressure under which they are required to operate and those performing similar duties shall be interchangeable with one another unless otherwise approved and of a higher rating than design pressure.

Globe valves shall have preferable curved or spherical seating and the discs shall be free to revolve on the spindle.

All non-return valves shall have an arrow cast or embossed on the side of the valve body to indicate the direction of the flow. For severe service conditions cushioned check valves are preferred to obviate valve clatter. In the case of swing - check valves the body seat shall be inclined at such an angle to the vertical as will facilitate closing and prevent clatter.

The internal diameter of all valve ends to be connected to pipes shall be the same as the internal diameter of the pipe to which they are joined so as to minimise use of reducers/ expanders.

Where applicable valves shall be of the outside screw and yoke type.

Main steam stop valve shall be fitted with indicators so that percentage of valve opening can be readily determined locally.

All the important valves shall be fitted with indicators so that percentage of valve opening can be readily determined locally and in the control room

Steam valves shall not be fitted in an inverted position. Eye bolts shall be provided wherever necessary to facilitate handling heavy valve or part of valves.

Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation and to ensure that minimum of maintenance is required .

All sampling and root valves furnished shall be of integral body bonnet type.

2.28.8 Pipe routing

- a. HP pipe from boiler to turbine will be routed with required loops and bends to meet the allowable forces & movements. The Bidder will submit the stress analysis. The piping will be routed in the boiler area taking support of the boiler columns and through the pipe rack between boiler and turbine area. This pipe rack could be below the connecting platform between the powerhouse and boiler operating floor. In the powerhouse area, the PRDSH stations will be located on top of the control room slab and HP pipe will then enter the powerhouse taking support of powerhouse columns and take entry to the turbine as per the STG design. The exhaust will be connected to header placed at 0

m level outside power house and further piping upto the distillery header. Balance piping will include: process return condensate and other miscellaneous piping.

- b. Water piping from DM tank and raw water reservoir to cogen plant and onwards to all usage points will be laid on pipe racks.
- c. Compressed air piping from receiver to usage points will be on pipe racks and along boiler and powerhouse columns.
- d. The integrated piping layout including locations of all pipe trenches and pipe racks will be provided by the Bidder during engineering for approval of Purchaser / Consultant. The pipe racks will be essentially located for aesthetic appropriateness and ease of man / material / vehicle movement. Minimum height of the pipe rack will be 5 m. All the pipe racks will be designed for existing pipe loads with 25% additional load bearing capacity. Typical design of the pipe rack on STADPRO or equivalent software will be submitted by the Bidder to the Purchaser / Consultant during engineering.

2.29 Painting

All metal scrubber shall be chemically cleaned, degreased and pickled in acid to produce a smooth surface, free of scale, grease and rusts.

After cleaning, phosphating and passivation treatment, the surface shall be given two(2) coats of zinc rich epoxy primer and backing in the oven.

Sufficient quality of touch up paint shall be furnished for application at site.

All parts which are subjected to wetting and drying alternatively shall be painted with three water proof coats as detailed below :

- a) First coating Bronze 75% coal tar 25%
- b) Second coating Bronze 50% coal tar 50%
- c) Third coating Bronze 25% coal tar 75%

All exposed steel and cast iron surface shall be given one coat of red oxide anti corrosive primer and 2 coats of enamel paint of approved colour.

- i) All metal surface shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structure shall be pickled and then rinsed to remove any trace of acid.

The under surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking finishing coat.

- ii) After preparation of the under surface, the relay and control panel/desk shall be spray painted with two coats of final paint.

Colour shade of final paint shall be Smoke Grey and shall be duly approved by the Purchaser before final painting is done. The finished panel/desks shall be tried in stoving oven in dust free atmosphere.

Panel finish shall be free from imperfections like holes, orange peels, run off paint etc. The Bidder shall furnish painting procedure details along with the bids.

- iii) All unpainted steel parts shall be cadmium plated or suitable treated to prevent rust corrosion. If these parts are moving element then these shall be greased.

Motor external parts shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale remove and treated with one coat of primer and finished with two coats of grey enamel paint.

The motor fan shall also be painted to withstand corrosion.

Appendix V provides the typical painting summary for exposed steel.

2.30 VFD Units

- **Construction Features**

- The Panels shall be dust , vermin corrosion proof construction sheet steel clad, totally enclosed compartmentalized cubicle design with front and rarer access. All the Panels shall be single busbar arrangement type with bottom cable entries.
- The VFD unit shall be suitable for the following operating system.

Rated Voltage : 415 V + & - 10 % , 3 Ph, 4 Wire.

Rated Frequency : 50 Hz + & - 5 % DC

Fault Level : 50 KA for 1 Sec for AC

Enclosure : IP 42

- Individual feeder modules organized in metallic segregated compartment.
- Vertical busbar serving to feeder modules in the vertical Panel or running through insulated cables.
- Cable Termination compartment , suitable for terminating the cables specified in the drawings
- Perforated sheet steel / insulating material enclosed horizontal auxiliary bus way for control, interlock, indication and metering wiring running horizontally.

- The front of the boards shall comprise of individually enclosed Drives, Starters, ACBs, MCCBs, and Switch disconnectors
- All auxiliary devices .for control, indication , measurement and protection such as control and selector switches, indicating lamps ammeters, voltmeters, energy meters, and protective relays shall be mounted on the front side of the respective compartment only.
- The design shall be such that unless required from maintenance/ inspection purpose all power on / off on start / stop and relay reset operations shall be performed without opening the panel board.

Busbars :-

The Cross section of the busbars shall be uniform throughout . The main busbar shall be sized for minimum 120 % of the full load current of the respective secondary of transformer. In any case , the current density shall be not more than 0.7 A/Sq.mm.for continuous operation or suitable for 50KA rating for one (1) second, whichever higher, for other busbars.

Marshaling Compartments .

- A common Marshaling Compartments / cabinets, as an extension, for the switchboards shall be provided, for connection of multicore cables from DCS racks. Marshaling compartments of adequate size shall be provided, 1 No. in each switchboard (Common for all VFD feeder in a particular switchboard) to house the interposing relays, multiplying relays . The terminal blocks shall be mounted in such way that FIELD terminal blocks/ termination and DCS terminal blocks / termination are accommodated on either side (Front and rear). However, sub-marshaling compartment may be considered and the interconnection between the sub-marshaling compartment and the main marshaling compartment through inter panel wiring shall be arranged by the bidder. All inter panel wiring between the individual modules, sub-marshaling compartment and the main marshaling compartment shall be with shielded cables through metallic troughs with cover.
- Marshaling cabinets shall house terminal blocks and transducers for connection to VFD compartments/ DCS racks, as shown in the drawings. However, local push button stations and other field instrument cables shall be directly connected to the respective motor feeder compartments. All analog cabling / wiring shall be of shielded type. Control supply shall be with 230 V AC.
- The terminal block arrangement shall be arranged as below :-
- All Digital Inputs (DIs) from different feeders to be terminated at a separate array of terminal blocks.
- All Digital Outputs (DOS) from different feeders to be terminate at a separate array of terminal blocks.
- All analog inputs (AIs) From different feeders to be terminated at a separate array of terminal blocks.
- All analog Outputs (AOS) from different feeders to be terminated at a separate array of terminal blocks.
- All terminal blocks shall be identified with the respective feeder names. The coloring of terminal blocks for the DIs, Dos, AIs, & AOs shall be unique for easy identification.

- The Communication port of all the Tri Vector Meters / KWH meters in the VFD Panel Board shall be connected in series through screened twisted pair cable of 0.5. Sq.mm. and a single point connectivity shall be provided in the marshaling compartment for hooking up these signals to the plant DCS . However, there shall be an independent terminal block individually for all the Tri-Vector Meter/ KWH Meter.
- The continuous current rating VFD shall be at least 110 % of respective connected motor FLC.
- The Output Choke shall be provided for the drives , which is provided with cable length beyond stipulated / recommended length by the VFD manufacturer.
- Each Out going feeder from VFD drive/ module shall be feeding to only one motor.
- Ammeter with selector switch and three (3) Nos. of CTs of Class 1 accuracy with selector switch shall be provided for all VFD
- The requirement of auxiliary contactor shall be provided to meet the control Philosophy as furnished.
- Each VFD shall be provided with suitable rating of semi-conductor fuses.
- Space heater supply for the motors more than 30 KW shall be extended from the respective VFD, When VFD is in 'OFF' condition.
- All the control circuits shall be provided with MCB control for isolation purpose.
- 10 Channel Temp Scanner with Alarm and trip contact shall be provided for pump motor.

2.31 DCS Based Instrumentation & Control

This section gives the general philosophy of the Instrumentation and Control System proposed for the proposed cogeneration power plant.

The Utility cogeneration power plant will be complete with the basic instrumentation and control system, necessary for its safe and efficient operation.

Comprehensive instrumentation and control equipment will be provided for each major areas i.e Boiler, Turbo-generator, Electrical system and Balance of Plant.

The control system shall be based on the State-Of-The-Art Distributed Control System (DCS) technology, with Data Acquisition and control of the key operational parameters.

The Centralized control / monitoring shall be from a Remote Central Control Room, where the DCS and its sub systems including the operator console, shall be located.

The key instrumentation and control system shall be as follows:

2.31.1 Boiler and its auxiliaries

The control of the boiler like operation / start up / shut down / trip, shall be realized directly from the DCS. All the signals required for controlling the boiler operation shall be processed by the DCS and necessary actuating signals for the various final control elements shall be driven from the DCS. The major control of the boiler includes the following, as a minimum:

- i. Drum level (3 element) control
- ii. Combustion control

- iii. De-aerator level control
- iv. De-aerator pressure control
- v. Furnace draft pressure control
- vi. Superheated Steam Temperature Control
- vii. Blow down tank level control
- viii. Soot blower control

Signals from the following shall be taken to the DCS for monitoring / interlocking purpose.

- i. Electro static precipitator / bag filter
- ii. Boiler feed pumps and transfer pumps
- iii. De-aerator
- iv. Chemical dosing
- v. Boiler safety and protection interlocks

2.31.2 Turbine & auxiliaries

The following controls of each of the turbine shall be performed by the DCS, as a minimum:

- i. Lube oil
- ii. Control oil
- iii. Turbine protection and safety interlocks

The following functions of the turbine shall be realized by dedicated independent micro processor based systems and shall be interfaced with the DCS through serial communication for monitoring / interlocking purpose :

- i. Turbine vibration monitoring
- ii. Turbine governing

The information of the following shall be monitored by the DCS for Data logging / Interlocking purpose :

- i. Power generation details
- ii. AOP / EOP / MOP status
- iii. Temperature of windings / Bearings of various pumps, generator etc.

2.31.2.1 The following details on the electrical signals shall be processed / monitored by the DCS for interlock / data acquisition purpose :

- i. Safety relay status
- ii. Generated voltage, current, kilowatt, KVAR, power factor, frequency

2.31.2.2 The instrument air compressor shall be controlled by their individual dedicated system. This system shall be interfaced with the DCS through serial communication for monitoring and data acquisition purpose.

2.31.2.3 Various electrical inputs from the transducers and the digital signals from MCC panels shall be processed in the DCS system for achieving the necessary interlocks / controls.

2.31.2.4 The PRDS functions, fuel and ash handling system, shall be directly processed by the DCS.

2.31.2.5 The design of the total control system will be such that the following sub system functions will be handled by the respective equipment:

- i. Data acquisition, display and logging sub system for monitoring, display, logging and printing of process parameters like flow, temperature, pressure, level, power, current, voltage, analytical and status will be performed by the operator station.
- ii. Start / Stop Sequence & Interlock sub systems consisting of the safety interlocks, Sequence of starting and stopping of the power plant and alarm generation will be achieved by a redundant DCS system.
- iii. Closed loop control sub system consisting of the continuous monitoring of the operational parameters like Level, Pressure, Flow etc. and controlling of the same using the PID functions will be achieved by DCS system.
- iv. Engineer / Operator Interface sub system consisting of setting / changing the operational parameters based on the experience of the operator and as a reaction to emergency situations will be achieved by the computers used as the operator station.
- v. Communication sub system for interconnecting all the above systems.
- vi. Data highway and network for connecting the control and data acquisition sub systems, operator interface sub systems to a duplexed data highway such that there will be information exchange among each one of them.
- vii. Auxiliary units such as system cabinets, printer consoles, marshaling cabinets and power supply distribution cabinets.

2.31.2.6 The Distributed Control System is proposed for control and instrumentation system, keeping in view the safety, reliability and availability for comprehensive presentation of plant operation status, trends and essential operator interaction facility.

The DCS based plant control will have the following inherent advantages:

- i. Integration of information from different individual controls provides centralized data on plant operation.
- ii. Increased reliability due to the use of Large Scale Integrated (LSI) components.
- iii. Increased flexibility for modification at any stage due to software configuration capability.
- iv. Better availability due to provision of critical module redundancy coupled with Auto / Manual stations.
- v. Modular design concept provides easy expandability for future in hardware and software.
- vi. Higher maintainability due to improved self-diagnostic and display features.

The major design aspects of the system will be as follows:

- i. Control will be of the type which normally relieves the operator of continual regulating duties and will be backed up by interlocks and safety systems that will take pre-planned action in cases where unsafe trends and / or conditions develop faster than the operator's ability to respond.
- ii. Continuous self checking features shall be incorporated in system design with automatic transfer to healthy / redundant circuits to enhance the reliability of the complete system.
- iii. All the closed loop analog signals shall be processed by the DCS. All the safety and interlock signals and digital signals shall also be processed.

- iv. Redundancy will be provided in the Central Processing unit, power supply (both at the CPU & I/O), I/O modules and communication modules (both between the controller and the operator station and between the I/O modules and the controller).
- v. Redundancy will also be provided for the communication cables.
- vi. Power supply used for interrogation with field devices shall also be redundant.
- vii. The DCS shall be provided with processor, power supply, communication and I/O redundancy for the entire system.
- viii. The Input / Output modules will be provided with noise filter and galvanic / upto isolation from external control source.
- ix. The Input / Outputs modules will also be provided with protection against reversal of polarity of supply voltage
- x. The inputs modules shall be suitable for processing the field signals. The outputs will be short circuit proof and protected by fuses.
- xi. The memory will be non volatile or battery backed up as required.
- xii. The programming language shall be based on logic statements / functional blocks.
- xiii. On line replacement of modules shall be possible without affecting the process (Hot swappable).
- xiv. Auto boot up facility for the DCS shall be within 2 minutes.
- xv. Display response time shall be less than 2 sec.
- xvi. Data communication net work response time shall be less than 100 m Sec.
- xvii. Closed loop control task execution (control response time) shall be done within 250 m Sec.
- xviii. Sequence control / Interlocks scan time should be within 100 m sec.
- xix. Display update time shall be less than 1 sec.
- xx. The system shall be designed so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.
- xxi. All equipment / systems located in the field shall be suitable for continuous operation without loss of function, departure from the specific function or damage at the ambient temperature and humidity conditions.
- xxii. The control system software shall have all the essential capabilities to perform advanced control algorithms as a minimum. It shall be user friendly, easily programmable and have excellent data acquisition, graphic display and logging capabilities.

The field instruments that are primarily responsible for measuring the process parameters will be having the following major design features:

- i. All the field instruments / equipment that are used shall be of the same make for ensuring the smooth and optimal maintenance including efficient spare parts management.
- ii. All field instruments used for sensing transmission and measuring shall be of electronic smart type with signal transmission in current mode of 4-20 mA.
- iii. All control valves and control damper drives will be of pneumatic type because of their fast response and ease of maintenance.
- iv. Appropriate de-rating of electronic components and parts.
- v. All the instruments shall have communication facility thro RS 485 interface.
- vi. Important plant parameters, that are required to assess the plant efficiency, must be serially communicated to the operator station for the purpose of display / logging.
- vii. All solid state systems / equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the specification requirements of surge protection.
- viii. All solid state electronic system / equipment furnished shall meet the requirements of Burn-in and Elevated temperature test.
- ix. All the instrumentation cables shall be flame retardant low smoke type.
- x. The instrumentation cables and wires shall function without breakdown for surges experienced in the control system. Voltage class and insulation level shall be compatible with the signals they convey.

The turbine shall be provided with an electro-hydraulic governing system. The system shall be designed such that the governing of the turbine shall be automatic and provides for safe operation.

All the conventional recording and annunciation methods will be dispensed with and instead it will be taken care by the DCS operator station in MMI.

Apart from the above integrated control system, local gauges will be provided near the equipment / pipelines at essential parts of the plant for the purpose of operator guidance.

2.31.3 Scope Of Supply

- a. Design, system & software engineering, manufacture, supply of hardware & licensed software, testing, inspection, Factory Acceptance Test (FAT) packing, forwarding, transportation, Site Acceptance Test (SAT), erection & commissioning, post commissioning assistance till plant stabilisation.
- b. The integration of all the inputs / signals for continuous monitoring, operation, data logging, data analysis, alarms, safety interlocks, annunciations etc. will be achieved through the DCS.
- c. The DCS will include the DCS control station, related licensed software & hardware, instrument & control cabling from the marshalling cabinet receiving signals from junction boxes of all cogeneration equipment, all MCC's and software links with Turbo-visory panel, Woodward Governor and turbine temperature scanner.
- d. The scope includes training, documentation, establishing communication between operating station and DCS and any other item, which is necessary for smooth operation of the system.

- e. Contractor to carry out engineering of system hardware and software to meet functional requirement outlined elsewhere. However, the system shall be freely expandable to reasonably high level, by adding hardware and related software without in any way, compromising the system capability with respect to system communication and memory to handle additional software.
- f. The entire cogeneration plant will be smoothly started, normally operated, provided with necessary interlocks & emergency trips, monitored, controlled and smooth shut down from the DCS.
- g. Supplier to provide the DCS with required software & compatibility with internet so as to transfer daily / shift wise MIS to Management / Senior officers of Plant

2.31.4 General Specifications For DCS

Distributed Control system shall be provided for the safe and efficient monitoring & operation of Co-generation plant (i.e. Boiler, Turbine, Generator and its auxiliaries, Balance of plant, electrical breakers etc.) in all regimes of operation.

The system shall be microprocessor based having functional distribution and data base distribution sub-system wise.

Signals from thermocouples & RTD's will be converted to mA signal by converter cards in Contractors marshalling cabinet.

The marshalling cabinet to have MTL 3013 or equivalent P&F isolation amplifiers for signals received from proximity switches.

a) Digital Inputs

Digital inputs shall be potential free. The inputs to the DCS shall be contact closures, closed during process normal conditions. Contact interrogation voltage shall be 24 V DC.

Loop current : to be informed by Contractor
 Galvanic / optical isolation : required for input channels
 Max. number of inputs per card : 32 nos.

b) Dynamic colour graphic displays

- i. All the process parameters, variables shall be displayed dynamically on graphic displays. Process data shall be visible on this screen with its equipment. Equipment shall be displayed in standard ISA symbols.
- ii. Normal operation & control of the process shall be possible using numerical keypads and functional keys on the console by monitoring the same on the screens.
- iii. The OS should perform all the normal plant operation, control & monitoring functions. It should be possible to select displays either through keyboard or mouse. Display should be updated at least once in one second.
- iv. Hyperlinks (Navigation buttons) shall be configured for navigating from one page to the other for a particular service.

c) Alarm:

Alarms shall be software configurable and shall be divided under following two categories

1. Process alarms : First out
2. Process alarms : Normal
3. Hardware & diagnostic alarms with error codes and description

Alarms shall be displayed on the console screen at the time of its occurrence. The same shall appear in the first out sequence. Alarms shall occur on the screen with its tag / description / process data.

Critical alarms should have time stamping in milliseconds. The same shall be also printed on the printer. Contractor shall add alarm text. ISA sequence shall be followed for alarms.

d) Push Buttons and Selector Switches :

Shall be software configurable on the screen which includes following

1. Momentary NO & NC push buttons
2. Latched push buttons
3. Two or three way position selector switches

e) Bar Graphs:

Bar graphs shall show the dynamic value of process parameters, which will correspond to numeric value in Engineering. Unit. This shall also be displayed in percentage value, engineering units. Bar graph for PID controller includes process variable, set point, remote SP, manipulated variable (MV) in different colours. Status of loop i.e. auto / manual / cascade shall be displayed alphabetically and with colour change.

f) Controller faceplate / Switch face plate:

Controller faceplate shall include numeric Engineering. Unit display and Bar graph for process variable, set point & manipulated value. Auto / manual / cascade operation shall be possible. Set point change & manual operation shall be possible from this faceplate. Manual to auto changeover & vice versa shall be bump less. Changeover from local set point also shall be bump less. PV / SP tracking in PID controller shall be possible.

Switch face plate shall include ON / OFF switches including start / stop PBs. Operation of start / stop push buttons / selector switches shall be possible from this faceplate. Feedback of start / stop operation shall also be displayed on this faceplate.

g) Tuning Display:

This display shall be useful for tuning of PID controller. This shall include controller faceplate. P, I, D values shall be accessible from this screen and can be changed only by engineer with password facility. Trending display to be configured for tuning controllers.

h) Totalliser:

Totalliser shall display the numeric totalised values of flow parameters. Reset facility for totalliser shall be available from same display screen with password or engineer login. It should be possible to change the totalliser constant from the faceplate. (These features shall have password lock facility)

All DO's shall be converted to plug in relays. Relay contacts shall be wired up to the terminals (1 fused terminal per output).

24 V power supply to digital input interrogation and analog transmitter power shall be provided. All phase supplies shall be of SMPS type of Phoenix / Mean well.

The system shall be able to operate satisfactorily up to ≤ 50 Deg. and 10% to 90% non-condensing humidity.

Modular system shall be adopted to facilitate easy system expansion. The type of modules shall be kept minimum possible in order to have inter-changeability and low inventory.

On-line replacement of any module shall be possible in such way that removal and addition of module shall be possible without switching off the power supply. Furthermore, there should not be any interruption of the system while replacing a faulty module wherever redundant modules are provided.

The system design shall ensure that no single failure in system results in any loss in system operation.

The system shall provide safe operation under all plant disturbances.

Galvanic / Optical isolation shall be provided for all field signals. Isolation shall also be provided between operator / engineering station and controller subsystem.

The system software shall be governed by the operation system running in a real time mode and shall be to meet all functional requirements specified elsewhere as a minimum.

i) Software

- (i) The configuration software for the DCS shall be in the functional flow diagram or ladder. Programs shall be protected from accidental changes by use of password. Development mode of MMI software to be provided for graphics modification.
- (ii) MMI Software to be loaded on a PC, i.e. operating station. There will be common PC operating cum engineering station. Engineering changes shall be password – protected. Contractor to provide configuration details of PC.
- (iii) Both run time and development software for intelligent devices like governor to be included. Necessary tags to permit future developments to be included in H.M.I.
- (iv) Only permanent license software to be provided
- (v) There must be total integration of all intelligent devices including AVR, governor LGPG relays and the DCS system.
- (vi) Contractor to note that all testing / checking / configuration of DCS will be carried out from a PC. The alarm registration time stamping shall be done at CPU level, Contractor to inform the resolution time.

- (vii) The system shall be capable of adapting to program changes without affecting the hardware and plant operation. It shall be possible to make logic changes and MMI changes on line without affecting control operation.
- (viii) For the programming / configuration of DCS, the operating station itself shall be used. Necessary hardware & software to carry out configuration, testing, debugging, editing of both DCS & MMI Software shall be supplied and loaded in the OS.
- (ix) Self-diagnostics should be in the form of error codes to indicate the type of error encountered by processor and other hardware. The various error messages with text shall be displayed on the operating station. The diagnostic features shall be programmed such that the error messages will appear on the operating station along with the text and can be acknowledged and cleared, whatever additional programming needs to be done for this shall be in Contractor's scope.
- (x) The system shall have self-surveillance, monitoring and diagnostic facility so that failure / malfunction can be diagnosed automatically to the level of individual channels of module level.
- (xi) The system shall be internally protected against system errors and hardware damage resulting from Electrical transients on power wiring Electrical transients on signal wiring and connecting and disconnecting devices or removing and inserting PCBs in the system.
- (xii) The system shall be capable of accepting various signal inputs for its direct use while preventing noise errors due to electromagnetic interface or radio frequency.

j) CPU

The CPU shall be Redundant and shall be provided with sufficient memory for the initial configuration plus 30% additional memory for future expansion. DCS should have adequate memory with EEPROM back-up and real time clock feature.

CPU shall retain its memory in the event of a power failure, with provision of battery back up, EEPROM and RAM

The DCS should be capable of freely mixing analog& sequence logic, executing user defined functions not included in standard functional blocks, storing control configuration in on-board non-volatile memory and providing an alarm indication for back-up battery low voltage, on-line tuning of PID control loops and other parameters. System shall be provided with protection against overload current and line voltage spikes.

Scan rate for the close loop/open loop on full load shall be 250msec (max)

The CPU shall be capable of executing the following control functions as a minimum

- a. Filtering
- b. Linearization including sq. root extraction for flow signal
- c. Alarms, limits, checking switches
- d. Integrating &totalisation

- e. Ratio / bias
 - f. Mid value selection
 - g. Transmitter failure detection
 - h. Function curve systems
 - i. PID loops, PID action and values shall be settable from OS
 - j. Auto manual bump less transfer
 - k. Output reversal block.
 - l. Range suppression for analog inputs
 - m. Set point ramp up / down function
 - n. Manipulated variable ramp up / down function
 - o. AND / OR / NOT and other logic gates / Time delays / Counters / Latches
 - p. Diagnostics
 - q. Feed forward control
 - r. Mathematical functions
 - s. Alarm / acknowledge / reset function
 - t. Auto / manual stations
 - u. Manual loader
 - v. Drum level pressure compensation
 - w. Bump-less switch over should take place from single element mode to three element mode and vice versa.
 - x. An alarm output shall be generated to announce the failure of any critical component such as DCS, power supply, I/O module, communications, etc. on the operating terminal.
- k) The capacity of the DCS system should be such that even after considering the space for future expansion, the loading should be lesser than 70% to permit required response time during peak loading. Free memory to be minimum 30%.

2.31.5 Other specifications for Distributed Control System (DCS):

1.	Processor redundancy	Required
2.	Communication redundancy between processor & HMI	Required
3.	Power supply redundancy	Required
4.	Time for backup processor to take over	Less than one scan cycle
5.	Memory utilisation of its capacity	60% max.
6.	Online configuration	Required
7.	Galvanic isolation for power supply	Required
8.	Optic isolation for Input / Output signals	Required
9.	No. of points per analogue input module	≤ 32
10.	No. of points per analogue output module	≤ 32
11.	No. of inputs per digital input module	≤ 32
12.	No. of outputs per digital output module	≤ 32
13.	Installed spare I/Os	25%
14.	Spare module space in racks	25%
15.	Spare capacity for system memory & user memory	30% minimum
16.	Future expansion capability	25%

17.	All spare points in I/O modules wire up to the marshalling cabinet	Required
18.	Commissioning spares and consumables	Required

2.31.6 Spare

Installed spare of 25% shall be provided for each type of the modules.

The controller and data acquisition racks shall have 25% usable spare space for installing additional I/O modules in future. In addition internal wiring for the same shall be completed up to I/O Terminal.

2.31.7 Other details

Location: Central control room (CCR)

- i. Monitoring of process parameters, equipment running status, motorised valves' open / close positions
- ii. Open loop controls viz. opening and closing of dampers, control valves, motorized valves, speed setting of variable speed drives in manual mode
- iii. Closed loop controls i.e. automatic controls viz. drum level control, furnace control etc.
- iv. Alarms: Process alarms viz. level high, pressure low etc. and overload / trip alarms of drives
- v. Operation: Start / stop drives, opening and closing of motorised valves. The operation from CCR shall be with safety interlocks, which shall be executed in respective panels or DCS from where the operation is carried.

2.31.8 Miscellaneous Items

Some special precautions to be taken by panel manufacturer during panel manufacture are as follows:

1. Terminal lugs shall be crimpable, insulated sleeve type for terminating external wires in the panel.
2. Sockets for powering external instruments shall be supplied / mounted by Contractor
3. Shrouding shall be provided for all terminals other than low voltage level instrument wiring
4. MCBs / Switches to have service and switch nos. punched on tags, duly installed on MCBs.
5. Instrument wires (for termination at site, if any) shall be terminated on plastic strip for easy identification at site.
6. 10% spare contactors and 25% spare terminals shall be given on each terminal strip
7. Terminals and wires for power incoming and distribution will be suitably sized.
8. Mounting arrangement to be provided for Back of panel instruments
9. Door limit switch should be covered.
10. Some field instruments shall be powered from control panel.

2.31.9 DCS shall have following features:

- (i) Alpha numeric and bar graph display of process parameter values

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Page 174 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

- (ii) Running status indication of drives on graphics
- (iii) Safety interlocks
- (iv) Close loop controls
- (v) Open loop controls
- (vi) Controller facia with indication of PV, SP, MV, A/M status, P, I, D values
- (vii) Setting of SP, manual loading, tuning of P, I, D constants
- (viii) Trend
- (ix) Alarm logging
- (x) Shift reports

2.31.10 **Controller And Data Acquisition Sub-System**

Controller and data acquisition subsystem is the main field interface subsystem and is capable of performing control and data acquisition functions either as one integrated subsystem or separate subsystem for each of these functions.

2.31.11 **Controller sub-system**

The control function of the system shall be executed by microprocessor based Controllers consisting of power supply modules, communication modules and I/O modules and a set of algorithms which are easily fields configurable using user friendly software.

The hardware capability of the controller shall primarily be exploited for regulatory control functions only. However, the sequencing and interlocking capability shall also be used.

Controllers shall be able to scan close loop in less than 200 milliseconds

Controllers shall be capable of accepting process signals from various field junction boxes, generator / turbine control panels and MCC's without any additional conditioning equipment.

The controller shall be capable of processing linear and non-linear analog inputs, providing square root extraction for flow signals, linearization and compensation for thermocouple. The controllers shall be able to generate 4-20 mA DC current signals for analog outputs and potential free contacts for the discrete outputs as minimum.

Loop integrity shall be maintained in controller sub-system architecture by providing one to one controller backup. In case failure is detected in the active controller all the loops of the failed controller shall have automatic control transfer switching, which shall transfer the entire configuration and data base of failed controller to the back up controller. Design must ensure that data integrity is maintained during switch over and no portion of data to be transferred is corrupted before and during switch over to the backup controller . The indication of the failed controller shall be displayed at local as well as on the central level.

Loop integrity shall be applicable to power supply modules and any other device associated with the controller sub- system.

The controllers shall be able to operate in either manual, auto and cascade mode. In cascade loops, the primary controller shall be able to track the stepping of the secondary controller is not operating in cascade mode. All controllers shall have facility for slow and fast ramping of stepping and output.

The controllers shall be provided with redundant power supply.

2.31.12 Data acquisition system

Data acquisition system shall interface and multiplex analog and discrete inputs from open loops. The inputs shall include 4-20mA DC thermocouple, resistance temperature detector and discrete contracts.

The system shall be capable of processing linear and non-linear analog inputs linearization of RTD inputs, square root extraction for flow inputs.

a) Analog input

Modules shall accept 4–20 milliamps signal from the 2 wire field transmitters

Max. number of inputs per card : 8 / or 16 nos.

24 V DC power required for 2 wire transmitter powering shall be supplied from a separate redundant power pack, which will be in Contractor scope.

b) Digital Output module

The output from DCS module shall be 24 V DC, which shall be supplied from the module itself. All the outputs going to MCC / solenoid valves (about 40 nos./ to be decided by bidder) / lamps or any other panel shall be though interposing relays.

Type of Digital O/P	:	24 V DC Potential output
Interposing relays	:	Relay Board with Phoenix, miniature relays, coil voltage 24 V DC, with LED for ON / OFF indication on relay board, contact rating 5 Amps, 230 C AC
Output status indication	:	Required
Galvanic / optical isolation for O/P channels	:	Required
Surge withstand capability	:	IEC 255-4
On DCS failure or card failure outputs should drop to ZERO State		
Max. no. of outputs per card	:	32 Nos.

DCS Contractor will require to provide power supply for the solenoid coils of boiler & turbine installation. About 40 solenoid coils each having 12 VA hold will need to be supplied.

The scan time for critical loops will be less than 50 m sec and for analog the cycle time will be less than 200 m sec.

Data acquisition system shall be provided with redundant power supply.

Each I/O shall be isolated from the external control circuit.

Each I/O shall be protected from short circuit and reverse polarity of power voltage.

Logic controller sub-system

The control functions required to implement the logic scheme shall be executed by microprocessor based logic control system, which consisting of power supply module, CPU module, memory module, communication interface module and I/O modules.

Memory shall be non-volatile. However in case volatile memory is provided, battery backup shall be provided with a minimum of 3 months lifetime to keep program storage intact. A battery drain indication shall be provided at least one week before the battery gets drained.

Redundancy shall be provided in such a way that in case of failure of the main processor, the standby shall take over automatically. The changeover shall be bump-less and the system shall be fail proof. The indication of the failed device shall be displayed at operator station
Each processor and each I/O rack shall have a separate independent power supply. Failure of one power supply shall not affect the system operation

Each I/O shall be galvanically isolated from external control circuit. The minimum isolation level between I/O and logic circuit shall be 1000 volts DC

Each I/O shall be protected against the reversal of polarity of the power voltage to I/O module.

Each I/O module shall have a LED per channel to indicate the status of each I/O

Input / Output modules shall be mounted by the DCS Contractor on suitable mounting rack in the panel. Replacement of I/O modules shall be possible without disconnecting field wires. It shall be possible to accommodate any type of I/O module in any sequence. All I/O modules shall have indicated LED on field side of I/O. Blank covers shall be provided for the spare I/O module slots on the I/O rack. All DCS hardware should be suitable for ambient temperature 60 °C and humidity 85%

Each input shall be provided with filters to filter out any noise in the input line and contact bouncing noise.

All inputs shall be provided with only dry contacts. All the inputs shall preferably be double ended i.e. two wires per input and not with common return for all inputs.

The interrogation voltage to the input contacts shall be powered form separate power supply.

The output from the system shall be potential free dry contacts

Each output shall be short circuit proof and protected by fuse. Visual indication of fuse blown must be provided for each module.

2.31.13 **Controller and data acquisition system loading**

The system loading for controllers and data acquisition system shall not exceed 60% or maximum 70% after considering the provided and required future space. The loading as indicated is the worst case of high system activity referred to the use of memory.

2.31.14 **Communication System**

The communication system shall be digital communication bus that provides a high speed data transfer rapidly and reliably between the operator station, process I/O devices and other devices connected to it.

Communication system shall be dual redundant, consisting of two separate communication buses and two separate communication system interfaces for each device.

The overall system performance shall not be degraded whether Communication system is 10% loaded or 100% loaded. Communication speed on the communication bus shall be sufficient to update the operator station data base one in every second.

In case of main bus failure or any communication device failure, the Transfer to the back-up device or bus shall be automatic without interrupting the system operation and without any operator's intervention. Information about the failed device/bus shall be displayed on the operator station.

It shall be possible to switch over the communication from main bus to the redundant bus manually without disturbing the system operation. It shall also be possible to connect or disconnect a device from the system without disturbing the operation.

Web Enabling Software to view & transmit data through internet is to be provided.

2.31.15 **Operator / Engineering Interface Sub-System**

- a) The operator interface sub-system shall provide the centralized information to the plant operator / Engineer in the following details.
- (i) Indication of all analog and digital process variables of control loops, open loops and all loop related parameters.
 - (ii) Manipulation of control loops including changing set point, mode, output, configuration, turning and computational constants.
 - (iii) Graphic displays and status indication.
 - (iv) Alarm displays and annunciation.
 - (v) Compilation of graphic displays.
 - (vi) Self-diagnostic messages.
 - (vii) Required interlocking schemes

- b) The Engineering interface sub-system shall be used for configuring, tuning and maintenance of the system. It shall be possible to perform the following system configuration functions.
- (i) Data base configuration including overview, group, loop, multi-loop and Multi-variable control configuration.
 - (ii) Configuration or re-configuration of alarms settings, their values, addition or deletion of any control block or component in loop
 - (iii) Tuning of control loops like changing P.I.D., dead time values, etc.
 - (iv) Compilation of graphic displays.
 - (v) Compilation of logs/report/historical trend points.
 - (vi) To call detailed self-diagnostic displays for maintenance aid.
- c) The operator /engineering interface sub system shall consist of two operator stations, in which any one of the stations shall be used as an engineering station
- d) Each operator station shall consist of TFT monitor and keyboard, each driven by independent electronics.
- e) The operator stations shall be housed in the consoles.
- f) Each Station shall be of industrial type and size shall be 22".
- g) LCD data, display update rate shall be less than one second.
- h) All the operator station shall be interchangeable. However under normal operating Condition, each operator station shall be assigned a specific area. The system shall have global database available at each operator station. Further any change made in the database of one operator station shall automatically update the database of other operator station.
- i) One logging printer and one alarm & event printer shall be provided. Alternatively, each engineering / operator station will be provided with one printer for sequentially logging data and alarm & events.
- j) Keyboard
- Keyboard shall be self explanatory, easy to operate and shall meet all the functions to configure, operate and maintain the system. A conversational user friendly software shall be used for operation configuration and maintenance of system.
- Keyboard shall preferably be touch sensitive Industrial grade membrane type. Each keyboard entry shall be registered with an audio beep.
- k) Process displays
1. Overview display
- Each display shall incorporate a minimum of 120 analog or discrete inputs which can be monitored simultaneously on the LCD screen i.e. page. Each page shall be organized into a suitable number of groups. Each group shall further incorporate suitable number of inputs i.e.

tags. Suitable identifications and description shall be shown for each group on the overview display to relate it to a loop display.

All analog points in the overview shall be represented as variable lengths indicating deviation above or below the normal operating value or set point.

Alarms shall be displayed in change of colour against each variable.

An input in alarm condition shall be identified by flashing. Control loops operating in manual mode shall be indicated

2. Group display

Group display shall be limited to the group of inputs as displayed in the overview display. Each group shall preferably include eight number of inputs.

Each input in the group shall be identified by the tag number, unit of measurement and process description which shall be displayed on the LCD screen.

Display, as a minimum, shall show following degree of details:

- Process variable in analog form shall show as a percentage of the transmitter span on a linear scale bar graph of 0-100% engineering units and in digital form as alphanumeric display in engineering units.
- Set point value in analog form as a percentage of the transmitter span on linear scale bar graph of 0-100% engineering units and in digital form alphanumeric display in engineering units.
- Output value in analog form as a percentage of the transmitter span on linear scale bar graph of 0-100% and digital form as percentage.
- Controller modes i.e. auto, manual & cascade.
- Process alarm on process variable, deviation or velocity
- Control valve failure position.
- The contact input/ output shall be represented by simulated graphic lamps and configurable alphanumeric status description.

It shall be possible to control the process from group view. Following control actions shall be possible.

- a. Increase/decrease of set point value either slow or fast.
- b. Change of controller mode i.e Auto / manual transfer
- c. Changing output to the final control element
- d. For digital points start/stop or open/close command.

3. Loop Display

Loop display shall provide a separate detailed display for each of the process inputs. The graphic representation of analog and digital points shall similar to group display. However in addition following information shall also be presented in alphanumeric form as a minimum.

- a. Controller tuning constants.

- b. Process variable zero and span values.
- c. Alarm set point on various parameters.
- d. Limits on set point, output, velocity etc.
- e. Controller action (direct/ reverse).
- f. Failure position of final control element.
- g. Engineering units.

It shall be possible to change the following through the keyboard of operator.

- a. Changing tuning constants (restricted by password)
- b. Changing scale, zero and span (restricted by password).
- c. Changing limits on set point, output, velocity etc.
- d. Changing configuration of any loop (restricted by password)
- e. Changing alarm set points.
- f. Changing control mode.
- g. Changing output to the final control element.
- h. To issue start/ stop or open/ close command for digital points.

Loop display shall also contain a trend displaying process variable, set point and output with sample interval time of maximum 1 second and full scale time base of minimum 60 seconds for tuning the process control loops.

4. Graphic display

It shall be possible to display dynamic graphic of different sections of the plant on the engineering station.

Graphic display shall be interactive type through which it shall be possible to control the process. It shall be possible to send motor start/ stop and shut down valve open/ close.

It shall be possible to view the process variable and alarm points and view and change steeping value, manipulated variable, controller mode etc from the graphic display.

The system shall have the capability of having and developing graphic symbol library as per ISA-5.1 and 5.3. Various colours used in the generation of graphics like colour of process lines, utility lines etc. The same shall be finalized during detailed engineering.

It shall be possible to go from any graphic page to related graphic pages or any group view or alarm summary.

5. Trend display

The system shall be capable of displaying the real time and historical trends for the parameters or variables like measured variable, set point, output, calculated variable etc.

The system shall also have a multi-trend capability in such a way that it shall be able to display set point, measured variable and output on the same display.

It shall be possible to display by scrolling or expanding the time base for all the time base for all the trends.

Historical data shall be stored on the non-volatile memory device like hard disc in such a way that such historical data can be utilized for archival storage and subsequent recall. Maximum possible period of storage shall be indicated by the Contractor.

Historical data trends shall be displayed for a minimum up to 25 hours for a data-sampling rate of 1 minute.

2.31.16 Alarm monitoring and display

A. Alarm management

It shall be possible to display process as well as system alarms on the operator station for operator's attention and action.

Alarm messages shall be displayed by flashing the page and group number of the input under alarm irrespective of type of display.

All alarms shall be displayed as and when they occur or generated with change in the colour of display in the following sequence, activating an audio signal.

The system shall not put off the audio alarm and visual flashing even after the condition returns to normal unless the operator acknowledges it.

B. Alarm summary display

It shall be possible to display summary of all alarms in the sequence of their occurrence and shall disappear from display only when they are acknowledged and cleared. The alarm display shall list the following for each alarm as a minimum.

- a. The date and time of occurrence.
- b. Tag number identification.
- c. Point description.
- d. Serial number of alarm in the sequence of its occurrence.
- e. The system shall be able to display an alarm summary

C. Alarm history

The history of alarm conditions shall be maintained in the database for alarm history display and printed on shift wise basis. The alarm display and print out shall list the following for each alarm as minimum.

- a. The data and time of occurrence.
- b. Tag number identification.
- c. Point description.
- d. Time of acknowledgement.
- e. Time of return to normal.
- f. The system shall be able to display and print out the alarm history of min of 300 alarms.

D. System alarm

Any abnormal condition in sub-system or any other functional device shall be displayed as system alarm messages on the operator station irrespective of the display selected.

E. Configuration display

Configuration display shall provide a separate detailed display for each loop indicating the configuration of that loop. When control requires more than one loop, all interrelated loops shall also be displayed. The following information is required in configuration display.

- a. Loop configuration giving designation of each block.
- b. Control block interconnection.
- c. Value of each block parameter time P.I.D, ratio, bias. dead-time etc.

2.31.17 **Logging function**

All parameters required for logging shall be stored in memory in accordance with data base update rate. However it shall be possible to perform basic arithmetic calculations such as averaging, summing, efficiency calculations etc prior to logging.

In general log format shall be user definable. However the same shall be given at the time of detailed engineering.

2.31.18 **Self diagnostics**

The self diagnostic message for a sub system failure shall appear on the operator station irrespective of display selected.

The system shall have an extensive set of self-diagnostic routines which shall locate and identify the system failure at least up to module level including redundant components.

At local level, failure of a module in a sub system shall be identified by an individual display.

Failure of a subsystem shall be annunciated with the change in colour.

One display page shall be available for each subsystem on the communication subsystem.

Data storage, archival and retrieval.

Historical data shall be stored on a non-volatile memory device like hard disc which can be subsequently recalled by operator on any screen.

It shall be possible to store and retrieve this data on removable mass storage media like compact disc.

2.31.19 **Measurement**

The following parameters, in minimum, will be measured, monitored, logged, integrated, displayed and collated in the DCS.

- a. Power (kWh, kVA, kVARH and other available parameters) from generator metering, power to distillery, feeder wise for cogeneration PCC, etc.
- b. Steam generated, steam to turbine, exhaust steam flow, steam exported to distillery, condensate from distillery (all steam and condensate flow transmitters to have one standby).
- c. Water (flow and total) for raw water, DM water, softened water, CT make-up, etc.
- d. Calibrated feeder movement for bagasse.
- e. All other measurements required for the control loops.

2.31.20 **Instruments**

Details of field instruments have been provided in the specifications of respective equipment. The same is also summarised below:

- a) All instruments and equipment shall be suitable for use in a hot, humid and tropical industrial climate in which corrosive gases and / or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof, weather proof to NEMA 4 (IP:55) and secure against the ingress of flue, dampness and vermin. All external surface shall be suitably treated to provide anti-corrosion protection.
- b) The instruments like control valves, thermo wells, orifice flanges, level instruments etc. coming on pipes and vessels under IBR shall be certified by IBR.
- c) Location of tap off connections shall be either from the side or from the top of the steam generator equipment but not from the bottom. This requirement is applicable to both pipes and vessels. The location of lower side connection shall be high enough to prevent plugging due to dirt or other suspended solids. In addition, the connections shall be short, vertical or horizontal and without any pockets.
- d) Materials of construction of instruments shall be consistent with temperature, pressure, corrosion conditions and other steam generator requirements.
- e) The design of control panel shall incorporate provision for expansion by installing space capacity. Each panel shall be designed to accommodate 10% minimum additional equipment including 10% spare cable/ tube entry points.

- f) Instrument power circuits shall employ an isolation transformer and individually protected from fault with the help of MCB's and fuses. Power supply to the individual instrument shall be disconnect able with the help of switch and protected with the help of fuse.
- g) Ranges for instruments shall be selected, in general, such that in normal process operation the indication on the indicator or chart is between 40% to 60% of span for linear and 60% to 90% of span for square root.
- h) The complete instrument system shall be designed for safe operation, by using normally closed contacts which open on fault conditions.
- i) Adequate alarms shall be provided to give audible and visual warning of malfunction. The Contractor shall also provide alarm contacts for the operation of parallel alarms, common pre-alarm and shut down alarm by the Purchaser wherever indicated.

All lamps shall be provided with lamp test facility.

- j) Gauge glasses shall be provided for all level measurements requiring automatic or manual control or monitoring. They shall have at least the same pressure and temperature rating as that of equipment's on which they are to be installed. They shall have ball check auto shut off valves.
- j) Isolation and bypass valves shall be installed with all control valves. Hand wheels and air lock valves shall be considered for all control valves.
- k) Control valve sizing formula shall, in general, be as per ISA-75, 07. Control valves shall be sized for the available pressure drop at normal flow and shall permit up to 110% of the maximum flow. The Contractor shall submit the sizing calculations for all control valves. DP shut off shall be 10% more than upstream pressure for actuator sizing.
- l) Orifice plate calculations shall in general, follow BS 1042. Orifice diameters shall be selected so that d/D ratio is between 0.2 to 0.7 for gases and steam and up to 0.75 for liquids. Contractor shall submit the sizing calculations for orifice plates.
- m) Main steam generator stop valve & air vent valve will be motorized and shall be designed in accordance with ASME code for valves (ASME B 16.34) and Indian Boiler Regulations.
- n) All transmitters shall be provided with output meter/output gauge at the transmitters end. All transmitters will be smart type.
- o) The Contractor shall ensure that the packing of instruments and associated equipment is adequate to prevent damage from such contingencies as rough handling, weather, condensation, dew, vermin and vibrations.
- p) All solenoid valves shall be universal type and continuous rated type.
- q) Contractor will adhere to the approved makes for all instruments as provided in this document. Contractor will provide data sheets for all gauges, transmitters, thermo-wells,

flow meters, energy meters, electrical meters, orifice, vortex meters, rota meters, impulse piping, etc. for approval of Purchaser / Consultant during engineering

2.31.21 **Basic Controls Design**

Generator, gearbox, turbine bearing temperature monitoring shall be through the temperature scanner.

Critical AI/AO/DI/DO signals will be redundant while non-critical & DAS points will be non-redundant. All controllers for critical controls will be redundant. The field inputs for critical inputs will be 1/2 logics.

Sequence of event recorder will be provided

Required Annunciation windows shall be included

25% spare I/O's to be considered.

TG governing will be by Woodward 505 E. However the critical parameters will be monitored by providing serial Modbus Interface

All I/O's will be potential free.

2.31.22 **Estimated Bill Of Material**

Sr. No	Description
	DCS System
I	As per I/O count to be derived by Contractor and approved by Consultant / Purchaser
II	Redundant Server or One Engineering cum operator station & 2 Sets of operator stations, TFT 22" color monitors, 1 color graphic laser printer and 1 A3 Dot matrix printer, required consoles with chairs, required hardware for SOE recorder, LED digital displays (150 x 250 mm) for power generation
III	Interconnecting cables between System Cabinets Marshalling cabinets Relay Cabinets
IV	Power Cable for system cabinets
V.	Erection Hardware
1.	Erection Material
2.	Cable Gland Wiring and cabling accessories
VI.	UPS Parallel Redundant 30 minutes battery backup.
VII.	Software
	Runtime + Development
	Run time software
	Project – application engineering Documentation Supervision of installation & commissioning
VIII.	Software link RS485, mod bus protocol for temperature scanner, TSI monitor, temperature scanner, Woodward governor, etc. (all placed within a radius of

	15m)
IX	Supplier to provide the DCS with required software & compatibility with internet so as to transfer daily / shift wise MIS to Management / Senior officers of Plant

2.31.23 I/O counts

The following are minimum I/O Counts to be provided by the bidder. The final I/O counts will be derived based on profibus / modbus communication and PIDs (whichever is higher & 25% spare I/Os above)

I/O summary for Steam Generator & Auxiliaries

DI (potential free)	: 210
DO (potential free)	: 160
Analog Outputs (4-20mA)	: 30
Analog Inputs	: 100
Analog Inputs (RTD)	: 64
Analog Inputs (Thermocouple, mV)	: 16

I/O summary for Turbine & Auxiliaries:

Digital inputs	: 60
Digital outputs	: 40
Analog inputs (4-20mA)	: 30
Thermocouple	: 16
RTD inputs	: 16
Analog output	: 16

I/O Summary for balance of plant:

Digital inputs	: 100
Digital outputs	: 60
Analog inputs (4-20mA)	: 24
Analog inputs (RTD)	: 10
Analog outputs (4-20mA)	: 16
Analog inputs (thermocouple)	: 8
MODBUS	: 10

List of minimum controls loop to be considered for Boiler

- i. Drum level control loop
- ii. Steam temperature control
- iii. Combustion control
- iv. Furnace draft control
- v. Soot blower control
- vi. De-aerator level control

- vii. De-aerator pressure control
- viii. PRDS steam pressure & water flow control – LP
- ix. CBD level control

The following interlock schemes for steam generator & auxiliaries will be operated through DCS and will have status indication on DCS:

- i. Boiler feed pump – 1
- ii. Boiler feed pump – 2
- iii. ID fan
- iv. FD fan
- v. SA / PA fan
- vi. Boiler interlocks
- vii. Pocket feeder # 1
- viii. Pocket feeder # 2
- ix. Pocket feeder # 3
- x. Pocket feeder # 4
- xi. Pocket feeder # 5
- xii. Pocket feeder # 6
- xiii. Pocket feeder # 7
- xiv. Pocket feeder # 8
- xv. Screw feeder # 1
- xvi. Screw feeder # 2
- xvii. Screw feeder # 3
- xviii. Screw feeder # 4
- xix. HP dosing pump # 1
- xx. HP dosing pump # 2
- xxi. LP dosing stirrer
- xxii. LP dosing pump # 1
- xxiii. HP dosing pump # 2
- xxiv. HP dosing stirrer
- xxv. Main steam stop valve
- xxvi. Main steam bypass stop valve
- xxvii. Air vent valve

Steam Turbine generator

- i. Lube oil system
- ii. Turbine Protection
- iii. Generator Protection
- iv. Panel Protection
- v. Turbine Run-up system
- vi. Temperature Scanner
- vii. Generator Cooling System
- viii. Turbo – Supervisory signals monitoring

ESP

- i. Transformer – start, trip, current, voltage
- ii. Micro-tapper panel – feedback, fault
- iii. Hopper heater – feedback, trip
- iv. Insulator – feedback, trip
- v. RAV – feedback, trip
- vi. Hopper – level high, temperature high, inlet temperature high
- vii. All safety interlocks

Electrical

- i. UPS status signals
- ii. DC power status signals
- iii. TVM meter and other energy meters - generation
- iv. KW / amps / on-off status of all continuously operating motors

Balance of Plant Area

- i. Ladder logic of fuel & ash handling system
- ii. Monitoring of control room temperature
- iii. All required mimics of the power plant

2.31.24 Uninterrupted Power Supply (UPS)

2.31.24.1 Scope Of Work

General Information		
Rated voltage	:	230 VAC
Rated frequency	:	50 Hz
Rated power	:	Minimum 10 KVA or above
Configuration	:	Parallel redundant
Codes / Standards	:	IS

2.31.25 Specifications of UPS

2.31.25.1 Requirement

The Contractor shall supply minimum 10 kVA or 25% higher than peak requirement, parallel redundant Un - interrupted Power Supply (UPS) in the scope. UPS with AC distribution board and accessories shall meet AC requirements of instruments, instrument panel, governor, relay, metering cum synchronizing panels, emergency power in CR & TG Deck and other Purchaser's

loads. Bidder to supply power sizing of UPS for approval prior to finalizing of the same. Bidder to provide UPS power to TG auxiliaries at one point in control room.

2.31.25.2 Standards

The equipment covered by this specification shall be in line with the requirements of the following IS, unless otherwise specified.

IS 1248	Direct acting electrical indicating instruments
IS 3136	Polycrystalline semiconductor rectifier equipment
IS 3700	Essential ratings and characteristics of semi conductor devices.
IS 3895	Mono-crystalline semiconductor rectifier cells and stacks
IS 4540	Mono-crystalline semiconductor rectifier assemblies
IS 5001	Guide for preparation of drawings of semiconductor devices
IS 5060	Code of practice for use of semiconductor junction devices

2.31.26 System Operation

2.31.26.1 The uninterrupted power supply system shall be complete with chargers, inverters, static switches, bypass transformer with Automatic voltage regulator and manual bypass switch. Normally the system will supply the load in UPS mode. In case of any trouble with one of the Inverter Sections, the load shall be catered by the redundant system if both the inverters fail, loads shall be transferred to the bypass transformer without any interruption.

2.31.26.2 A manual by pass switch (make before break) shall be provided to isolate the inverters and static switches for maintenance.

2.31.26.3 When it becomes necessary to boost charge the battery (i.e. when the battery has discharged during mains failure), the charger shall be set to the boost mode manually. The rectifier section shall now cater for boost charging the battery and at the same time supplying the inverter. After completion of boost charging, the charger shall be reset to float mode manually.

2.31.26.4 It shall be possible to run the system at rated load for half an hour and at about 75% load continuously without any damage in case of failure of cooling fans.

2.31.27 Design

2.31.27.1 The charger shall have necessary features to prevent damage to the battery. The output voltage (110 V AC, single phase and 230V AC single phase) shall be stabilised to within +/- 5% variation, for mains input (415 V AC, three phase) variation of +/- 20% in voltage and +/- 5% in frequency. The source fault level at the point of supply shall be 50 MVA. Charger shall have adjustable current limiting feature controlling the output current and the battery current in float and boost mode. Charger output to the battery shall be passed through a smoothing circuit so that the ripple content is limited to a value safe for the battery.

- 2.31.27.2 The charger shall be designed to boost charge the completely discharged, batteries in 10 hours. The changeover between boost charge mode and float charge mode shall be affected manually. Necessary alarms to indicate battery discharged and DC over voltage conditions shall be provided. Selector switch shall be provided for selecting the float charge or boost charge mode.
- 2.31.27.3 The inverter unit shall be designed to operate from the charger output continuously without use of battery smoothing effect. With the battery connected to the UPS system, a filter shall be provided at the input of inverter unit to reduce-the AC feed back from the inverter to the battery to a maximum of 2%. Efficiency of the Inverter shall not be less than 80% at rated load and pf. The output waveform distortion shall not be greater than 3%.
- 2.31.27.4 The inverters shall be suitable for synchronising with the mains having frequency variation of +/- 3%. The inverters shall be de-linked when the variation exceeds this and shall run on its own oscillator maintaining its output frequency to +/- 1 % of 50 Hz.
- 2.31.27.5 Current limit protection shall be provided which will protect the inverter against overloads and short circuits at the output. The current limit shall be adjustable. Once the overload is removed, the inverter shall automatically resume normal operation.
- 2.31.27.6 UPS shall be designed to withstand 125% overload for 15 minutes and 150% overload for 10 seconds.
- 2.31.27.7 The inverter output shall have spike / surge suppression filters to protect the loads.
- 2.31.27.8 By-pass transformer shall be natural air-cooled type suitable for indoor location. Links shall be provided on 415 V windings to give offload tapings of +/- 2.5% & +/- 5% of normal voltage.
- 2.31.27.9 A manual Bypass switch, make before break type, shall be provided to take the system out for maintenance without interrupting power to the load. The switch shall be mounted in the inverter section. The enclosure to be of IP 3X or better.
- 2.31.27.10 The Contractor shall ensure that neutral of the all transformers are solidly connected to earth to ensure that the potential between earth and neutral is zero at all conditions

2.31.28 **Cabinets**

- 2.31.28.1 The UPS shall be housed in a 2 mm thick sheet steel Cabinet with separated panels for housing the charger, inverter and Bypass transformer. The panels shall be freestanding, front aligned, dust and Vermin proof with suitable ventilation Louvers and cooling fan. Hinged doors shall be provided at the front and back, as required, with dust tight gaskets. Inter panel sheet steel barriers shall be used.
- 2.31.28.2 The enclosure degree of protection shall be minimum IP 21. The cable entry shall be from the bottom. A removable bottom gland plate shall be provided fitted with double compression type cable glands for external cable connections. Elmex type clamp terminals shall be provided for wires up to 16 sq. mm. and terminals for, large size shall be bolted type complete with cable lugs.

- 2.31.28.3 All switches shall be rotary type mounted on the front of the door. Fuses shall be HRC link type. Busbars shall be colour coded and live parts shall be properly shrouded to ensure complete safety to operating / maintenance personnel. All instruments shall be switchboard type, back connected, 96 mm square. Scale shall have red mark indicating maximum rating.
- 2.31.28.4 An earth bus, suitably sized, shall be provided at the bottom of the panels with provision for earth connection at both ends to existing main earth grid. All non-current carrying metallic parts shall be earthed.
- 2.31.28.5 Anti condensation heaters, thermostatically controlled shall be provided in each vertical panel complete with switch fuse unit/MCB.
- 2.31.28.6 Each panel shall be provided with one 5A receptacle and switch and panel lighting.
- 2.31.28.7 Distribution board at the outlet of UPS system shall be provided with adequately sized incomer FSU (single phase) and outgoing FSU feeders as below, for continuous use.
- | | | |
|---------------------|---|--------|
| a. Incomer 250 Amps | - | 1 No. |
| b. Outgoing 32 Amps | - | 3 Nos. |
| c. Outgoing 16 Amps | - | 6 Nos. |

2.31.29 **Battery**

Set of indoor sealed maintenance-free battery of capacity to meet the UPS back -up requirement for half-an-hour with all necessary accessories and devices as required for satisfactory functioning of the system shall be included in scope.

By pass Supply Voltage Stabilizer

By pass supply shall be taken through servo stabilizer.

Voltage stabilizer output regulation shall be + / - 1 % for 0-100% load variation and full range of input supply variation over the entire power factor range.

2.31.30 **Static Switches**

Static switches shall be solid state with performance characteristics matching with the Inverters. Controls permitting manually actuated transfers to either source shall be provided. Actuating device of such controls shall be so located or guarded to prevent accidental operation. On the front of panel an indication shall be provided for each static switch to show its position.

2.31.31 **Metering, Indications and Alarms**

The following metering and indications shall be provided on each panel :
Charger Panel

- a. Incomer AC supply voltage with selector switch

- b. Incomer AC line current with selector switch
- c. Output voltage charger
- d. Output current charger
- e. Battery charging/discharging current
- f. Indicating lamps for A. C .input supply 'ON', output supply 'ON'.
- g. Indicating lamps for battery on float / Boost.

Inverter Panel

- a. D.C. Input current
- b. Bypass transformer secondary voltage
- c. UPS output voltage with selector switch
- d. UPS output current with selector switch
- e. Frequency meter
- f. Power factor meter
- g. Indicating lamp for Battery output 'ON'.
- h. Bypass supply 'ON'
- i. Load on Bypass
- j. Mains synchronized.

2.31.32

Audio Visual Alarm

(Shall be provided for the following complete with ACCEPT, RESET and TEST facilities)

Charger Panel

- a. Mains Under Voltage, single phasing, in case of three phase input.
- b. Charger / Diode Failure
- c. Cooling fan tripped (Common for all fans)
- d. Low battery voltage
- e. DC over-voltage
- f. Battery earth fault

Inverter panel

- a. DC input failure
- b. Inverter -I output failure
- c. Inverter -II output failure
- d. Load-on by pass
- e. SCR fuse failure
- f. UPS output under voltage

Potential free 'NO' contacts for annunciation for all the above (rated for 2 A, 230 V DC) mentioned alarms shall be provided, wired up to terminal strip and to be grouped separately for charger and inverter unit.

2.31.33

Inspection and Testing:-

Signature and Seal of the Bidder

HBL/TEN/PUB/20-21/223 dated 06.02.2021

Page 193 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

The following tests shall be carried out on the system to ensure its successful operation as per the specification.

The system shall run under rated load at rated power factor for a minimum continuous period of 10 hours. Output voltage, current, frequency and critical temperatures shall be recorded. Test shall also be done with the fans off and the system loaded as described in this specification.

Output voltage and frequency regulations on various load combinations from 0-10 % load.

Over load withstand test as per this specification shall be carried out immediately after continuous operation on rated full load and maximum operating temperature (hot condition).

Waveform analysis with Oscilloscope under the following conditions shall be done.

Full load conditions

Simulation of input AC-power failure to the rectifier.

Simulation of battery charger failure and battery failure.

Simulation of failure of inverters (causing the full load to be transferred to the By Pass supply)

Manual return of full load at rated power factor from Bypass supply to the inverter.

Short circuit the output bus to record the current limiting effect of the inverter.

Reverse input polarity test.

Test on all controls and Alarms for correct setting and operation.

Test and calibrate the instruments.

2.32 Fire Fighting System

Fire fighting scheme meeting TAC recommendations and ensuring plant & personal safety will be constructed.

Pressurized fire hydrant system will consist of a pipe network and hydrants positioned around the station in sufficient numbers and so located that all buildings and risks are readily protected. Necessary number of loops will be formed around various risks. Major areas to be covered are incineration boiler, ESP, power house and fuel storage. Fire hydrants with spray nozzles to be provided at appropriate distance of about 25 m to cover these areas.

The loops will be interconnected for better reliability of the system. To isolate a portion of the ring main because of damage/repair, suitable nos. of valves will be provided.

The hydrant network will be sized and analysed to ensure that about 3.5 kg/cm² pressure is available at the hydraulically remotest point in the system with the existing hydrant pumps. Head of existing pumps is 70 m. The velocity in the hydrant main will not exceed 2 m/sec.

The fire alarm system shall consist of smoke detectors, heat detectors, fire alarm panel, hooter, manual call point etc. The detectors shall be located in all the electrical panel rooms, control room and battery room. The manual call point and hooters shall be located throughout the entire TG building. The detectors will sense the fire automatically and will generate fire alarm through Fire alarm panel.

The portable fire extinguishers shall consists of dry chemical powder type, carbon-di-oxide type, foam type fire extinguishers. The extinguishers shall be located strategically inside the TG building, electrical rooms and near generator transformer.

For fuel handling system, spray nozzles will be provided on top of the conveyors or on the canopy at 2 m spacing and will be provided fire water through a distributor pipe with required deluge valves. All pipes will be GI of heavy grade. Heat detectors will be provided at 25 m spacing. The same system will be provided, excluding heat detectors for the fuel storage yard. The coal covered storage yard will be about 2500 sq.m and bagasse storage yard will be 1000 sq.m.

Passive type fire fighting to be provided as per norms for the generator transformer including fire extinguishers and sand buckets.

HVWS system to be provided for STG lube and control oil tanks, coolers, pumps area. Quartzoid bulb detectors to be provided for fire water sprinkling to cover the entire area. Required HVWS projectors to be provided in the spray pipes. Hydraulically operated deluge valves to be provided.

2.32.1 System Requirement

The fire protection system is required to ensure protection of the facility in order to combat an outbreak of fire, so as to reduce damage and consequential losses. The fire protection system includes fire detection, containment and suppression systems. The proposed fire protection system will be designed to provide adequate safety measures in the areas susceptible to fire in the power plant in compliance with the recommendations of the Tariff Advisory Committee (TAC) for insurance companies.

The entire fire fighting system will have a centralised panel housing the required electrical, mimic of the system and will be hard wired to the centralised DCS to show the mimic and provide alarms.

The indicative area wise requirement of fire detection and protection system will be as given below:

SR. NO.	AREA	TYPE OF DETECTION	TYPE OF PROTECTION
1.	STG Lube Oil Storage Tanks and Purifiers	Quartzoid Bulb Detectors	As per TAC norms
2.	Cable Vault in Electrical / Control Building	Ionisation type smoke detector with linear heat sensors	Portable Fire extinguisher
3.	Control Room	Addressable smoke detector of Ionisation & Photoelectric type	Portable Fire extinguisher
4.	Switchgear Room, MCC Rooms in Control/Electrical	Addressable smoke detector of Ionisation & Photoelectric type	Portable Fire extinguisher

SR. NO.	AREA	TYPE OF DETECTION	TYPE OF PROTECTION
	Building		
5.	Battery Room	-	Portable Fire extinguisher
6.	Electrical Rooms in various Buildings Plant	-	Portable Fire extinguisher
7.	Conveyors	Heat detectors will be installed at all junction towers, at all locations of fuel transfer and at every 25 m of conveyor length with interconnectivity to a water sprinkler system	Pressurised water sprinkler system.

Apart from the above power house, boiler area, BFW pumps, compressor and fuel storage area will be protected with hydrant system.

2.32.2 Interconnection to Existing Fire Fighting System

The existing fire fighting system piping near fermentation house can be assessed at a distance of about 40 m from proposed incineration boiler front area.

Hydrant System

Pressurized fire hydrant system will consist of a pipe network and hydrants positioned around the station in sufficient numbers and so located that all buildings and risks are readily protected. Necessary number of loops will be formed around various risks.

The loops will be interconnected for better reliability of the system. To isolate a portion of the ring main because of damage/repair, suitable nos. of valves will be provided.

The hydrant network will be sized and analysed to ensure that about 3.5 Kg/cm² pressure is available at the hydraulically remotest point in the system with the hydrant pump discharging at rated head and capacity. The velocity in the hydrant main will not exceed 2 m/sec.

Hose pipes of suitable lengths along with standard accessories like branch pipes, nozzles, spanners, etc. will be provided. These will be kept in a central hose house for the outdoor hydrants. Each internal hydrant valve will be provided with individual hose box having glass front containing hose pipes, hose reel, branch pipes and nozzles etc.

Minimum running pressure will be 3.5 Kg/Cm² at the base of each hydrant.

The general design of hydrant valve will conform to IS: 5290.

2.32.3 Portable Fire Extinguishers

Following types of portable fire extinguishers will be provided for the entire power plant area at strategic locations, as per applicable norms.

- a) 2 kg capacity dry chemical powder fire extinguisher.
- b) 5 kg capacity dry chemical powder fire extinguisher.
- c) 2 kg capacity CO₂ type fire extinguisher.
- d) 5 kg capacity CO₂ type fire extinguisher.

2.32.4 Piping System And Valves

Both Hydrant and spray system piping will be run underground and through Hume pipe at road crossings. Piping will be of mild Steel pipes(galvanized or un-galvanized) of 'Medium' grade conforming to IS: 1239/ 3589 or equivalent acceptable international standard and coating and wrapping as per IS:10221. Provisions will be made for extension of hydrant and spray system piping for future extension of the project.

Piping for compressed air, breaching connections, drains, down stream of deluge valves will be of heavy grade galvanized type.

All firewater piping will be capable of being drained completely and provided with drain cocks / valves at low levels.

2.33 Specification for Erection of Mechanical Equipment

a) Checking of foundations

The Bidder shall as a first field activity, check the foundations for the correctness of the same as per relevant drawings & and certify the same for concreting and the same may be rechecked for its correctness after concreting, such as levels, location of bolt holes, sleeves, pockets, openings, fixture plates and other embedment in RCC works, etc. All the structural fixtures required shall be supplied by the Bidder.

Where required by manufacturers the concrete surfaces shall be chipped and finally dressed up true to obtain the required contact between sole plates and concrete surfaces. The fine dressing of the concrete shall be with Prussian blue match checks.

Bidder shall ensure that while lifting turbines/generator, piping and other auxiliaries for transporting, slings shall be put over the points indicated on the equipment.

Slings over casing shall have gunny bags or soft wood packing to avoid the scratches and nicks on the equipment.

Slings / D-Shackles of proper sizes shall be used for all lifting and rigging purposes. All care shall be taken to safeguard the equipment against any damage.

Bidder shall thoroughly clean all machine surfaces / slings, surfaces/keys, brackets sole plates etc. and apply anti-scuffing paste or other recommended equivalent before assembly of the said parts. The components whose surfaces are coated with protective coating are to be thoroughly cleaned.

The Bidder shall carry out all necessary checks such as accuracy of levels, centres lines, bolt positions, of installation of all equipment covered in the scope of work.

b) Checking of Equipment after Grouting

After the grout is set and cured, the Bidder shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centring of rotors with respect to their seating 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 Bidder in a manner acceptable to the Purchaser.

c) Shaft Alignment

All the shafts of rotating equipment shall be properly aligned to those of the matching equipment to the required accuracy.

The equipment shall be free from excessive vibration so as to avoid over-heating of bearing or other conditions which may tend to shorten the life of the equipment.

All bearings shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

The Bidder shall maintain a record in the form acceptable to Purchaser / Consultant of all the operations carried out on each weld and maintain a record indicating the number of welds, the names of the welders who welded the same.

All site joints shall be subject to acceptance of Purchaser / Consultant. Any joints declared rejected shall have to be redone at the Bidder's cost.

The Bidder shall carry out the tightening of the bolts on the equipment and piping covered under this specification by using either the calibrated torque wrench method or the turn of nut method.

The methods used, the tools and the equipment deployed shall be subject to the approval of Purchaser / Consultant. The bolting work shall be carried out by competent technicians.

The Bidder shall install all necessary platforms, stairways and ladders required for the safe and convenient operation and maintenance of all the equipments, valves etc. covered in this specification at no extra cost.

The Bidder shall completely erect all the equipments for the complete E & M portion including hangers and supports, valves & accessories in accordance with the approved drawings.

This includes all necessary bolting, welding, testing and cleaning. Systems shall be demonstrated in condition to operate continuously in a manner acceptable to Purchaser / Consultant.

Welding shall be used throughout for joining pipes except where flanged screwed or other type joints are lines & elevation as indicated in the drawings.

While erecting the field run pipes the Bidder shall check the accessibility of valves, instrument tapping points and maintain minimum head room requirements and other necessary clearances for adjoining work areas.

The Bidder shall be responsible for correct orientation of all valves so that seats, stem and hand wheels will be in desired location.

All supports & hangers for the pipes have to be fabricated and provided for approximately every three metre (3 Mtr.) of pipe.

However in any case sufficient numbers shall be provided so that the deflection of pipe between hangers shall not exceed the limits indicated in the drawings.

The Bidder shall make all necessary arrangements including making of temporary closures on piping / equipment for carrying out the hydrostatic testing on all piping / equipment with motor operated pump.

All piping flanges are required to be blue matched using surface plate to obtain at least 80% contact area before installation.

All welded joints of pipes shall be cleaned of welding slag's, & burrs by hand file wire brushes and flexible grinders wherever required and using white cloth. No cotton waste shall be used while cleaning the equipment / piping

All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section IX of ASME & IBR.

These welding procedures shall clearly state the type of material, thickness, the joint details, the repeat temperature maintained, the post-weld heat treatment given, the welding current and voltage used during qualification of welding procedures.

For all high pressure piping welding, the latest applicable requirements of the Indian Boiler Regulations must be complied with.

All records of the welding procedures, the welders qualifications, tests and welders performance details for the work performed under these specifications shall be maintained by the Bidder and be made available to the Purchaser on request.

Wherever applicable, the Bidder will submit :

- All non-destructive examination procedures, stress relief and /repair procedure actually used during fabrication.
- Welder and welding procedure qualification certificates.
- Welder identification list, listing welder's and welding operator's qualification procedure and welding identification symbols.
- Material mill test reports on components as specified by the specification.
- The inspection plan with verification, inspection plan check points, verification sketches, if used, and method used to verify that the inspection and testing points, in the inspection plan were performed satisfactorily.
- Sketches and drawings used for indicating the method of trace ability of the radiographs to the location on the equipment.
- Non-destructive examination result report.
- Stress relief time temperature charts.

The Bidder shall dismantle the valves & actuator for overhauling, servicing and lubricating wherever required as advised by Purchaser/ Consultant.

The Bidder shall also lap or grind the valve seat for ensuring the satisfactory performances of valves at no extra cost. All consumables such as gaskets, gland packing which form the permanent part of equipment shall be in the Bidder's scope.

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

All temporary rigging 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 secured in place by temporary pinned or blocked solid during the test.

The Bidder shall carry out the pre-commissioning activities such as chemical cleaning of piping system, water flushing, flushing of oil systems, flushing of control fluid system.

The scope of pre-commissioning activities covers installation of all temporary piping, supports, valves, tanks, pumps & all other accessories & services to complete the process.

The Bidder shall carry out the edge preparation of weld joints at site in accordance with the details acceptable to Purchaser/ Consultant.

Wherever possible machining or automatic flame cutting will be allowed only wherever edges preparation otherwise is impractical. All slag / burrs shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of Purchaser / Consultant.

Bidder shall carry out all the electrical pre commissioning tests on the generator, excitation system, as stipulated by the relevant specification and codes.

The Bidder shall hand over all parts/materials remaining extra over the normal requirement with proper identification tags, in a packed condition to the Purchaser / Consultant.

The work to be carried out is of highly sophisticated nature requiring quality precision workmanship, engineering and construction management.

It should also ensure successful and timely commercial operation of equipment in stalled. The Bidder must have adequate quantity of precision tools, construction aids in his possession. Bidder must also have adequate trained, qualified and experienced supervisory staff and skilled personnel.

All temporary scaffolding shall be removed before the start of the commissioning activities to prevent hazards.

2.34 Specification for Erection of Electrical Equipments

a) Scope

The specification covers the installation, testing and commissioning of all electrical equipments and accessories required for the power plant for efficient and trouble free operation.

b) Standards

The electrical installation work covered by this specification shall unless otherwise stated comply with the requirements of the latest edition of relevant Indian Standard, statutory regulations and codes of practices.

- Indian Electricity Rules.
- Tariff advisory committee.
- IS-10118 : Code of practice for selection, installation & maintenance of switchgear and control gear
- IS-6600 : Guide for loading of oil immersed transformers
- IS-3043 : Code for practice for earthing
- IS-2309 : Code of practice for protection of building and allied structures against lightning
- IS-2274 : Code of practice for electrical wiring installation
- IS-6665 : Code of practice for industrial lighting

c) General Requirements

The installation shall be carried out by an electrical Bidder holding a valid license as required by the State Government. The Bidder shall provide particulars of the license held by him or his sub-Bidder to the Purchaser.

The installation shall require approval of the Chief Electrical Inspector to the Government of Bihar and the Bidder shall prepare all necessary drawings / documents in obtaining the approval.

He shall also fully assist the Purchaser in obtaining approval from any other statutory authorities for the successful commissioning of the power plant and the Substation.

Any modification in the equipment or installation that may be demanded by the inspector shall be carried out at no additional cost to the Purchaser.

In accordance with the specific installation instructions or as directed by the Purchaser, the Bidder shall unload, erect, assemble, install, wire, test and commission all electrical equipments included in this tender. Equipments shall be installed in a neat workmen like manner with highest regard for safety.

Erection materials, tools, testing instruments or any other machinery of any nature shall not be supplied by the Purchaser.

The Bidder shall arrange for the same in a timely manner and he shall not be allowed to claim for any delay or extra cost of any nature.

Consumable materials of any nature required for the job shall also have to be arranged by the Bidder.

Clearing the site after completion of erection as well as regular clearance of unwanted materials from site, returning all packing material and excess material shall also be covered under the scope of work.

All equipments and instruments of indoor and outdoor, shall be inscribed with number, nomenclature, danger boards and other instructions.

The Bidder shall touch up the surface for all equipments, which are scratched and / or damaged during transportation and erection. The paint used shall match exactly the surface being touched up.

The Bidder shall employ skilled and semiskilled labourers for erection, installation & testing as required.

All electricians, cable jointers, wiremen, welder and others employed shall be suitably qualified possessing certificates / licenses recognised by the competent authorities.

The Bidder shall also furnish a list of Engineers /Supervisors and staff employed by him for erection and installation jobs, giving in brief, qualification and experience of such staff and indicating whether they hold such competency certificates / licenses to supervise the electrical installation jobs as required under Indian Electricity Rules & State electrical inspectorate Rules.

The Bidder shall set up his own workshop and other facilities at site to undertake fabrication jobs, pipe bending, threading etc.

The Bidder shall be responsible for recording of all readings and observations during erection, testing and commissioning, in registers or on prescribed performs.

All such test data and records shall be duly signed by the Bidder's Engineer / Purchaser's representative and shall be submitted to Purchaser in triplicate.

The Bidder shall carry out all tests at site for outdoor and indoor Electrical equipment and commission the installation in the presence of Purchaser's representative . The Bidder shall be responsible for final adjustment of relays, instruments, meters breakers etc and also for submission of relay settings and calculations.

All support insulators, Circuits breakers, Isolators, Instrument Transformers, etc. shall be properly handled and erected as per the relevant codes of practice and manufacture's drawings and instruction manuals.

Handling equipment, sling ropes etc. should be tested before erection and periodically for strength.

Necessary Junction boxes for CTs and PT's shall be supplied and installed.

- **Panels :**

- a. All the switchgears shall be checked for dimensions as per manufacturers drawings. The locations of switchgears shall be checked as per the layout drawing. The base plates, channels to be embedded in the trenches well in advance of the actual erection of panel. Clearances required as per drawings shall be checked by the contractor.
- b. The switchgear shall be handled with care under guidance of a competent supervisor. Base channels shall be grouted, on leveled cement concrete. All foundations grouted bolts shall be cured for a minimum period of 48 hours.
- c. All the panel shall be assembled, aligned and leveled as per the instructions of the manufacturers given in respective drawings. It should be checked that panel to panel coupling bolts and bus bar links fit properly without any strain on any part. It should also be checked that lowering, lifting, racking in and out of breakers and all motions are free from any obstructions. The fixing bolts shall be grouted only after satisfying all the requirements. The hardware used for this purpose shall be zinc passivated.
- d. After completion of the panel erection, all the cubicles, switches, starters, CTS, bus bar chambers should be cleaned and checked for tightness. All wiring connections shall also be checked for their correctness as per drawings. Metering and protective CT as per the polarities and phase sequence.
- e. All starters, switches, contactor contacts should be cleaned with C.T.C.

- f. At Hinges of panel, doors should be lightly lubricated to give free and noiseless movement.
- g. All the control wiring, bus bars, other live parts of switchgear and incoming and outgoing cables should be meggered with 1000 V megger for L.T. panels. 5KV megger shall be used for 11KV Breaker Panel.
- h. The panels must be completely sealed to prevent entry of any dust, vermin & rodents.
- i. The gland plate shall be drilled for the no. of cables as per cable schedule, extra holes shall also be drilled and sealed with rubber grommets for any additional cables. Gas cutting shall be never be done.
- j. The panels must be cleaned with a vacuum cleaner. All loose material lying in the panel shall be removed.
- k. Before commissioning any switch gear panel, the following points must be checked and ensured for safe energisation of the board.
 - The erection of panel to be commissioned is complete in all respects including all mountings and earthing.
 - That all the openings in floor inside and outside the panel have been sealed off.
 - That all the metering instruments have been checked and calibrated.
 - That all control fuses are of proper rating and showing continuity
 - That all the indicating lamps are healthy and in position.
 - That the H.V. Test of breakers bus bars and outgoing and incoming cables has been conducted and is satisfactory.
 - That IR value has been recorded for bus bars. Circuit breaker, incoming and outgoing cables.
 - That all the surroundings and panels have been cleaned and temporary earth leads have been removed.
 - That mechanical and electrical interlocks are OK.
 - Each panel before erection shall be checked for all above and shown to purchaser at site. Joint inspection report shall be made.
 - The record of tests carried out/changes made in wiring and locations of panels shall be made for future references.

The specifications given in this section are also applicable to all panels in general. The guidelines provided in this section need to be followed in addition to the specific instructions provided by individual panel manufacturer.

- **Cables:**

- a. All the cables required for the work will be supplied by contractor. This shall include taking the delivery at site, shifting to locations, cut to lengths, laying, dressing, testing and commissioning with termination arrangements.
- b. The cables shall be laid in trenches, trays or conduits Cable routing given on the drawings shall be checked in the field to avoid interference with structures, piping ducting and minor adjustments shall be made to suit the field conditions.
- c. All cables shall be carefully measured and then only cut to the required length leaving sufficient length for final connections to the equipment on site.
- d. The contractor shall confirm the exact requirement of cable for particular feeder by measuring at site along the actually finalized route. He shall prepare cut length schedule of cables before taking up cable laying.
- e. Cables shall be laid in complete uncut length from one equipment to other.
- f. Cables shall be neatly arranged in the trenches/trays in such a manner, that crisscrossing is avoided and final take off to the motor/switch gear facilitated. Arrangement of cables within the trench/ tray shall be the responsibility of the contractor.

- g. All cables shall be identified close to their termination point by cable numbers as per schedule. Cable numbers will be punched on aluminum strips (2 mm thick) securely fastened to the cable and wrapped around it.
- h. Temporary ends of cables shall be protected against dust and moisture to prevent damage to the insulation. While laying the cable, ends of cables shall be taped with PVC tape
- i. Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with protective cover until the final termination to the equipment is completed.
- j. Where cables rise from trenches to motor, control station, lighting panels etc. They shall be taken in GI pipes for mechanical protection up to a minimum of 1000 mm above ground level. The diameter of the GI pipe shall be at least 3 times the diameter of the cable. The upper end of pipe shall be sealed to prevent ingress of water.
- k. Cable ends shall be carefully pulled through conduits to prevent damage to the cable.
- l. Wherever cables are taken in conduits, the contractor shall ensure that the area of conduit filled in by cables shall be as under :-

1 Cable in pipe	:	53 %
2 Cable in Pipe	:	50 %
3 Cables in pipe	:	43 %
More than three cables	:	40 %

If more cables are passing, additional conduit shall be laid after the cables are installed and all testing is complete, conduit ends above grade shall be plugged with suitable weather proof plastic compound.

- m. Where cables pass through foundation wall or other underground structures the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations, structures, the electrical contractor shall identify the same and obtain an approval before cutting the same.
- n. Cables installed above ground level shall be run in trays, exposed on walls ceilings / structures and shall be run parallel to or at right angles to beams walls or columns. The cables shall be so routed that they will not be subjected to heat.
- o. Individual cables or small groups which run along structures will be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars at a spacing of 300 mm. The cost of such saddles shall be included in the cost of installation of cable.
- p. Cables shall be supported so as to prevent sagging. G.I. clamps required as per the diameter and number of cables shall be on cables at every 300 mm.
Cable carrier system i.e. cable trays / supports and supporting steel shall be painted black before laying of cables.

● **Cable Termination & Testing :**

- a. All XLPE / PVC cables shall be terminated at the equipments/ panel by means of single compression type glands and tinned copper lugs.
- b. Power cables shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections are made necessary bimetallic washers. shall be used.
- c. In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of grooved PVC ferrules. Wire numbers shall be as per inter-connection diagrams to be furnished to the contractor.
- d. Contractor shall drill holes for fixing glands wherever necessary at no extra cost.

- e. The cable shall be taken through adequate size gland inside the panel or any other electrical equipment. The individual cores shall then be dressed and taken along the cable ways .
- f. Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors. Crimping shall be done by hydraulic crimping tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping
- g. After completion of the termination the waste material such as PVC insulation removed from cables, cable pieces & amour strips etc. Shall be immediately removed from the work place and shall be to appropriate place allotted for this purpose.
- h. Before energizing the cables following tasks shall be carried out -
 - checking of identification Nos.
 - Measurement of resistance.
 - Insulation resistance.
 - Pressure Testing in case of 11KV XLPE cable.

Proper records shall be maintained for future reference.

• **Cable trays & supporting system :-**

- a. Cable trays of sizes as per drawing shall run in concrete trenches or overhead supported from columns, slabs etc.
- b. Cables shall be clamped in both horizontal and vertical runs by suitable clamps.
- c. Cable trays and supporting system shall be adequately provided to provide mechanical support during operating as well as short circuit conditions.
- d. The cable trays and supports shall be applied with two coats of red oxide primer and two coats of epoxy paint.
- e. Cable trays shall be fabricated from MS angles and strips as per sizes given in respective drawing.

• **Illumination system :**

- a. Outdoor type street light fittings shall be mounted on GI pipe bracket with clamps welded to fabricated tubular pole.
- h. Power supply to street light fitting is to be provided by looping the PVC cables coming from Lighting Panel up to junction box. From junction box flexible copper cables shall be provided to fitting.
- i. All hardware items such as nuts, bolts, washers, anchor fasteners used for mounting lighting fixtures shall be zinc passivated
- j. The lamps / tubes shall be handled carefully and shall be fitted just before commissioning of illumination system.
- k. For installation and termination of PVC cables the details specifications are given elsewhere in this document with shall be followed.
- l. Before energizing the installation, insulations resistance test shall be carried out.
- m. Illumination level shall be measured with lug meter in indoor and outdoor areas.
All the test results shall be handed over to client.

2.35 Erection & Commissioning for DCS

2.35.1 General Specifications

Bidder's scope for erection and commissioning services includes:

- a. Receive / Handling
- b. Stock

- c. Security
- d. Issue
- e. Installation
- f. Erection
- g. Commissioning
- h. Supply of commissioning spares
- i. Handing over
- j. Drawings & Manuals and
- k. Training to Purchaser's project and O & M teams

Unloading, handling and storage at site, pre-fabrication/assembly if any, civil inputs, erection, testing, commissioning, trial operation, final painting and guarantee performance testing.

Providing warehousing, testing facilities, obtaining approvals from statutory authorities and providing required documentation, data etc. All Equipment and instruments required for erection, start-up, initial filling, commissioning and performance guarantee tests.

The Bidder shall deploy erection Bidders who have carried out similar or larger jobs and will present their credentials for approval of Purchaser / Consultant.

The Bidder shall be required to erect all mechanical & electrical equipment, Steel work, chutes, hoppers, instruments and controls cables and conduits. etc complete in all respect.

The Bidder shall provide all skilled, semi skilled and unskilled workers, Supervisory staffs, tools and tackles, erection materials hosting testing of equipment and other related services required to complete the erection and commissioning all equipment with auxiliaries.

The work shall include the following.

- a. Receipt of material at site
- b. Providing storage and safe custody of the equipment.
- c. Checking of the foundations.
- d. Alignment , levelling and grouting .
- e. Current / drilling / welding as required on the existing structure / buildings.
- f. Complete assembly and erection materials .
- g. Minor rectification work wherever required.
- h. Final painting .
- i. Initial lubrication and greasing.
- j. Trial run and commissioning.

3.1 MAJOR CIVIL WORKS

Bidder to provide all required inputs including load data, drawings and layouts as inputs for designing the civil works for all plant & equipment in his scope. Design and construction of civil works will be done by Purchaser.

- a. Foundations for main boiler columns, ESP, auxiliary foundation columns, panels, deareator etc.
- b. Foundations and basin for cooling tower
- c. Foundations for fuel and ash handling equipments, feeding tunnel, crusher house
- d. Panel rooms and other auxiliary buildings
- e. Foundations for large tanks including slop, condensate etc., pumps, fuel conveyors, pipe racks, pipe / cable racks
- f. Panel rooms, sheds for equipments
- g. Drainage channels, storm water drains
- h. Underground cable & bus ducts, tunnel for fuel handling etc.
- i. Earthing pits and earthing mats.
- j. Miscellaneous foundations for pumps etc.

CHAPTER – 4

APPROVED LIST OF VENDORS, LIST OF SPARES AND LIST OF DRAWINGS/ DOCUMENTS

Approved makes are specified in the tender for various equipment /materials, but it is sole responsibility of the bidder to ensure that all equipment /materials of best quality & genuine make are procured and decision of Purchaser with regard to selection of any of the makes stipulated in the tender shall be final. In case specifications/ make of any item or work is not mentioned in the list of approved list for any particular item then contractor has to provide the documentary proof for the same & basis the documentary proof, Purchaser may approve the revised specification / make on their sole discretion.

4.1 APPROVED LIST OF VENDORS

4.1.1 Major Equipment Suppliers

Steam generator	Thermax / IJT / KCP / Qualified Bidder
DCS	Yokogawa / Honeywell / ABB / Siemens / GE

4.1.2 Mechanical

Air Conditioning System	Blue-Star / Voltas / Carrier
Bearings	SKF / FAG
Bellows	Lone Star / Metallic Bellows / Instrumentation Ltd. / Cori Rubber
Belt Weigh Scale	PBL / IPA / Avery
Blow down valve	Levcon/BHEL/Hopkinson
Boiler Feed Pumps	KSB / Kirloskar Ebara / Sulzer
Butterfly valves	KSB / BHEL / LBT / Instrumentation
CBD & IBD Valves	BHEL / Hopkinson / Fainger Laiser / Forbes Marshall/KSB
Chains /Sprockets	Diamond / Rolcon
Conveyor Belt	Dunlop / Andrew Yule / Ravasco / MRF
Couplings (Tyre Type)	Fenner
Coal crusher & screen	Sayaji, Ecoman
De-aerator	Thermax / BHEL / L&T
Dust Extraction System	Ecomak / Duvent
ESP	Thermax / BHEL / Alstom
Fire Hydrants / Fire Extinguishers	Fireflex / Minimax / Minimak / Alert / Kafex / Safex
Fire Protection systems (CO2)	New Fire / Vijay / Agni Heavy Ind/ Mather & Platt

Gate, Globe & Check Valve CI 600 and above	BHEL / KSB / Crane/ Forbes Marshall
Gate, Globe & Check valves	BHEL / KSB / Crane/ Forbes Marshall
Turbine Gear Box	Flender / Skoda / Mitsubishi / / Hitachi / Triveni / Siemens
Gear Box	Elecon / Premium/Nord
Governor	Woodward 505 E
GVC	Eskay / Patel Air Temp / Mazda / TEMA
HP & LP Dosing system	/ Asia LMI / Enpro /
ID, FD and SA Fans	AYL / ABB / BHEL / Batliboi / Reitz
Insulation	Lloyds / Minwool / Orient
LRSB Soot blowers	BHEL / Hopkinson / RR
Lube oil purifier	Alfa Laval / Pennwalt
Magnetic Separator	Electromag / Sterling / MCI
Misc. valves & specialties	Fouress / Audco / KSB / Steel Strong
Non IBR valves	L&T / KSB/BHEL/ Forbes Marshall
NRV	L&T / KSB/BHEL/ Forbes Marshall
Oil coolers	Eskay / Reynolds / Southern Lubricants
Oil filters	Industrial Enterprises / Southern Lubricants / Enpro
Oil Pumps	Delta / Sigma Lutin
Pumps	KSB/Khimline / Sulzer / Beacon Weir / Micro Finish
Refractory	ACC / KFS / Furnace Fabrica
Relief valves	BHEL / L&T /Crane/ Forbes Marshall
Resins for WTP	ION Exchange / Thermax / Nalco
Rotary Soot Blowers	Hopkinson / BHEL
Rupture disc	FMC Sanmar / Eagle / Burgmann
Safety Switches	AG / ABB / AE/GE
Safety valves	BHEL / L&T / KSB/ Forbes marshall
Spring hangers	BHEL / L&T / Sarathi
Vibratory Screen	Sayaji, Ecoman, Durgapur
Welding Electrodes	Advani Oerlikon / Esab / Hannover / Lincoln

4.1.3 Electrical

Air Circuit Breakers	ABB / GE Power / L&T/ Siemens / Schneider
Analog Meters	AE / IMP / Rishab
Annunciators	IEC / Minilec / Procon / Alen / Sun Auto
Auto Excitation Regulation System (Digital)	Basler / BHEL / Elin / GE / Siemens / ABB
Auto Synchroniser	Alstom / AVK-SEG / L&T / Siemens / Woodward
Battery	Amara Raja / Exide / Universal (BUI) / Panasonic/V-Guard

Battery Charger	Amara Raja / BCH / Trittech / Chhabil / Sab Nif / Universal / Masstech
Busduct	Elpro / Power gear / General / BHEL
Capacitor Banks	Ductail / L&T / Malde / Siemens / CGL/Madhav
Control panel	Auto Con, Logix, Future Electronics
CTs & PTs	ABB / AE / CGL / KAPPA
DC Distribution Board & EOP starter	Alstom / GE Power Controls / L&T / Siemens / ICA / BCH / BHEL
Digital Meters	AE / Enercon / L&T / Siemens
Distance Protection Relays	ABB / Alstom / Easun Reyrolle / GE / Siemens
FD, TPN SFUS	L & T /Schneider /Siemens/ABB
Fuse Bases and HRC Fuses	L & T /Siemens/ABB
Generator Protection Relays	ABB / Alstom / Beckwith / GE Multilin / Siemens/Schneider
Illumination System	Bajaj / CGL / Philips / Wipro/Havells
Indicating Lamps	Technic/Siemens/ L & T
Instrument Transformers	AE / Intrans / Kappa / Pragati / Prayog / Silkans
LAVT & Terminal Cubicles	Elpro / Enpro / Power Gear / Suman Controls / VEE VEE Control /
Lighting fixtures	Bajaj/Crompton Greaves/Wipro/ Havels
Lightning Arrestors	IGE / Elpro / Lamco / Oblum / WS
LT Motors	ABB / CGL / Siemens / KEC / NGEF / Havels
LT Panels	ABB / Alstom / GE Power Controls / L&T / Siemens / CPRI approved
LT Switchgear Components	ABB / GE Power / L&T / Siemens
Master Trip & Auxiliary Relays	ABB / Alstom / Easun Reyrolle
MCB ELCB	MDS Legrand /Indokopp/Groupe Schneider
MCB Distribution Boards	L&T / MDS / Siemens / Datar / CPRI approved
MCCB	Siemens/ABB/ L & T
Microprocessor Based Motor Overload Relays	Alstom / Siemens/ Schneider
Power & Control Cables	CCI / FGIL / RR / Ravin /Torrent / Universal / Finolex/Havells / KEI
Power Quality Meters	GE Multilin / L&T / Enercon / Conserv
Pressure Gauges	Bells / GIC / H. Guru / Waree
Protection, Metering, Synchronising & Control Cubicle	ABB / Alstom / Easun Reyrolle / Elpro / Enpro / Siemens
Protective Relays	Areva / Siemens / L & T /SEGC/ABB
Push Buttons	L & T /Siemens/Technic/Vaishno
Relays	Siemens/ Schneider/ABB/L &T/ Alstom / AVK-SEG
Rotor Earth Fault &	ABB / Alstom / AVK-SEGC

Sensitive Directional Earth Fault Relays (Microprocessor / Numerical Version) RELAYS	
Selector Switches	Kaycee/Salzar / AE
Semiconductor Fuses	Feroz / GE Power / Siemens
Surge capacitor	Madhav / Narkhade
Temperature Scanner	ABB / Massibus / Yokogawa Bluestar
Transducers	ABB / AE / Siemens
Trivector Meters	ABB / L&T / Allen Solly
Variable Frequency Drives	ABB / GEC / Siemens / DELTA / L&T
XLPE Cable Termination Kits	3M Birla / CCI / M-Seal / Raychem

4.1.4 Instrumentation

Air filter regulators	Shavo-Norgon / Placka
Analysers	ABB / Rosemount / Yokogawa / Emerson
Control valves	MIL / ARCA / Fouress / IL / ABB / Dresser / Fisher
Desuperheaters	ABB Introl / Chemtrol Forbs Marshal / Key Stone
Draft Gauges	Switzer / Bells / Levcon
Flow nozzles / Orifice	Micro precision / Hydro pneumatics / IL / General instruments / Gurunanak /
IP converters	Bells / Rosemount / JNM / ABB / MIL / MTL
Power cylinders	Bells control / IL / Chemtrols
Pressure gauges	H. Guru / GIC / Bells / Waree
Pressure switches	Switzer / Danfoss / Infoss
Steam traps	Spirax Marshall / Pennant / Greaves Cotton
Strainers	Spirax Marshall / Triveni / Strainwell
Temperature Gauges	H. Guru / GIC / Bells /
Thermocouples	General Instruments / Pyroelectric / Altop / Toshniwal
Transmitters	Rosemount / Honeywell / Yokogawa / Bells / Moore / E&H
UPS	APC / DB / Emerson
Ventilation system	ABB / C-Doctor / Crompton / GEC / Voltas
Vibration system	Bently Nevada / Shinkawa / Provibtech (USA)

4.2 LIST OF SPARES

Details of all the spare parts are required to be provided in the item master format (format will be shared by Purchaser to L1 bidder after award of PO) which will include all the technical details regarding the spare parts along with indicative price, approved suppliers with their details for ease in procurement after installation

4.2.1 List of Spares for steam generator

Sr. No.	Item	Unit	Quantity (MIN)
A.	Pressure Parts		
	<ul style="list-style-type: none"> Gaskets for drum manhole 	Nos.	2
	<ul style="list-style-type: none"> Pressure part bends Tubes : 	No.	5 of each type 5% (to nearest figure) of all profiles for furnace, water walls, Eco, APH & SH
B.	Non Pressure Parts		
1.	Spares for drum safety valve <ul style="list-style-type: none"> Valve disc Adjusting rings Spindle Gasket / Packing 	No. No. No. set	1 1 1 1
2.	Superheater safety valve <ul style="list-style-type: none"> Valve disc Adjusting rings Spindle Gasket / Packing 	No. No. No. set	1 1 1 1
3.	Isolating valve for main steam <ul style="list-style-type: none"> Gland packing for main steam Gasket Packing 	Set Set Set	1 1 1
4.	Feed water isolating valve <ul style="list-style-type: none"> Glands packing for isolating valve for feed water Gasket 	Set Set	1 1
5.	Packing ring isolating valve for Attemperator <ul style="list-style-type: none"> Gland packing for isolating valve of 	Set	1

	attemperator <ul style="list-style-type: none"> • Gasket • Packing ring 	Set Set	1 1
6.	Feed water control valve a) Gland packing b) Seal ring c) Body bonnet gasket	Set Set No	. 1 1 1
7.	SH Spray Control Valve <ul style="list-style-type: none"> • Gland packing • Seal ring • Body bonnet gasket 	Set Set No.	1 1 1
8.	Fans (Non drive & drive sides) <ul style="list-style-type: none"> • ID fan bearing • SA fan bearing • FD fan bearing 	No. Set Set	1 1 1
9.	Rotary Feeder (Non drive & drive sides) Set of bearings	Set	1
10.	Boiler feed pump spares (like seals, gaskets, bearings (DE & NDE) for both pump & motors	Set	1
11.	Valves (high pressure) 25 NB 50 NB 100 NB 200 NB		2 1 1 1
12.	Fuses		2 nos. for each motor
13.	Push buttons & indicating		2 nos. of each type
14.	Description Thermocouples Annunciator lamps Pressure gauges – shatter proof glass Temp. gauges – shatter proof glass Level gauge toughened glass	1 of each type 1 of each type 1 of each type 1 of each type 1 of each	

		type	
15	Soot Blowers		
	- Packing	1 Set	
	- Oil Set	1 Set	
	- Bushing	1 Set	
	- Blowing element pipe (for retractable type soot blowers)	1 no	
	- Lance tube (for retractable type soot blowers)	1 no	
	One set of geared unit with motor for LRSB	1 unit	
	One set of carriage for LRSB	1 unit	
16	Puppet valve assembly	1 no	
	Stoker		
	- End Grate Bar	50	
	- Middle Grate Bar	25	
	- Skid Shoe	15	
	- Grates	25	
	- Bearing Shoe	15	
	- Bearing housing	2	
	- Skid Rail	5	
	- Rear end floating seal bracket	2	
	- Chain Links	5	
	- Front and Rear skid rail	5	
	- Rear end Floating Seal	2	

	- Hardware (HT bolts with nut, spring & washers)	50	
	- Grate locking pins with nut and washers	15	
	Deaerator		
	- Spray Nozzles	5 Nos.	
	Refractory		
	Special Shaped Refractory Bricks	10 nos. tiles of each type – 1 set	
	Electrostatic Precipitator		
	- Shaft Insulator	1 No.	
	- Support Insulator	2 Nos.	
	- Bushing Insulator	1 No.	
	- Rapping Motor	1 No.	
	- Heating Elements	4 Nos.	
	- Emitting Electrodes	4 Nos.	
	- Dust Level Indicator	1 No.	
	- Microprocessor Based Controller	1 No.	
	- Hammer assembly for collecting electrodes	5 Nos.	
	- Hammer assembly for emitting electrodes	5 Nos.	
	- For bag filter, bag cages & bags	5% of total	
	- For bag filter, solenoid valves	1 of each type	
	Feeding System		

	Spares for bagasse extractor and screw feeder consisting of:		
	- Coupling for drum feeder	1 Set	
	- Coupling for screw feeder	1 Set	
	- Bush	1 No.	
	- Belt pulleys for drum feeder (drive & driven), expansion bellow	1 set.	

4.2.2 List of Spares for cooling tower

Sr. no.	Description	Unit	Quantity
1.	Motor bearings DE / NDE	Set	1
2.	Set of oil seal	Nos.	2
3.	Bolt, nut and rubber bush	Set	2
4.	Sprayers / nozzles	Set	10
5.	Bearing for gear box	Set	1

4.2.3 List of Spares for Electrical Distribution (As applicable)

Item No.	Description	Unit	Quantity
1	Battery charger & DCDB		
1.1	AC fuses of each rating	Nos.	2
1.2	DC fuses of each rating	Nos.	2
1.3	Bridge protection fuses of each rating	Nos.	2
1.4	Control fuses of each rating	Nos.	2
1.5	DCDB fuses of each rating	Nos.	2
1.6	SCR bridges of each rating	Set	1
1.7	Indicating lamps	Nos.	2

4.2.4 List of Spares for DCS

Item No.	Description	Unit	Quantity
1	DCS		
1.1	Analog control I/O module card	Nos.	1
1.2	Digital input module card	Nos.	1
1.3	Temperature (T/C) input module card	Nos.	1
1.4	Temperature (RTD) input module card	Nos.	1
1.5	Terminal boards	Nos.	1
1.6	Input signal conditioning card	Nos.	1

1.7	Output signal conditioning card	Nos.	1
1.8	Signal distributor	Nos.	1

4.2.5 List Of Spares For Balance Of Plant Equipments

Sr. no.	Description	Unit	Quantity
1	(b) Plant Air Compressors		
1.1	O ring	No.	1
1.2	Sight flow glass	No.	1
1.3	Oil Filters	No.	1
1.4	Gasket bearing. Housing Drive side	No.	1

4.2.6 List Of Spares for Fuel & Ash Handling Plants

Item No.	Description	Unit	Quantity
1	Fuel Handling Plant		
	Chain Conveyors (As applicable)		
1.1	Chain	M	20
1.1.1	Slats	Nos.	15
1.1.2	Sprockets	Set	1
1.1.3	Bearing for head and tail sprockets	Sets	1
2.	Ash Handling System		
	Belt Conveyors		
2.1	Idler rollers for each belt width	Set	1
2.1.1	Carrying	Nos.	1
2.1.2	Impact	Nos.	1
2.1.3	Return	Nos.	1
3	Screw Conveyor		
3.1	Hanger bearing bush	set	1

4.3 LIST OF DRAWINGS & DOCUMENTS

4.3.1 General

All I.B.R. test certificates required to be submitted to the Boiler directorate/chief inspector of Bihar and all approvals to be obtained by the Bidder. It shall be the responsibility of the Bidder to provide all necessary information / documentation / follow up and arrange inspection of the Boiler Inspector. The responsibility of the steam generator Bidder regarding IBR shall be only to be completed after handing over of P.O. and steam (Safety Valve) test certificate from the Boiler Inspector, along with required documents & drawings.

Single line drawing to be provided by Bidder will inter-alia include: 3 element drum level control, de-aerator level and pressure control, furnace draft control, steam temperature control etc. Bidder will provide P & I drawings for feed-water system, de-aerator cum storage tank, blow-down tank, combustion control, LP & HP dosing, sample coolers arrangement, steam line, air line, fuel feeding, GA, plot plan, etc. Detailed list of drawings for information / approval to be freeze during kick-off meeting.

All the drawings shall be approved and vetted by the Purchaser /their Consultants.

All drawings which are to be approved and finally approved drawings, instruction and maintenance manuals of all equipments and other details will be handed over as under before commissioning.

- (a) 6 sets for the Purchaser including soft copy on CD.
- (b) 2 sets for the consultants to the Purchaser including soft copy on CD.

The Bidder shall submit all major drawings for approval, as well as a drawing list from which the Purchaser/Consultant will select those drawings which they consider necessary for completion of drawing approval. Before starting manufacturing of the equipment, the Bidder shall have to take approval of the design drawings from the Purchaser/Consultant. Any manufacturing done prior to approval of the drawings shall be rectified in accordance with approved drawings by the Bidder at his own cost, if any discrepancy arises and the equipment shall be supplied within stipulated period.

General Arrangement drawing shall be submitted for approval to the Purchaser/Consultant prior to the commencement of detailed engineering by the Bidder. These drawings shall show to scale, location and size of building facility and all major equipment including electrical. Equipment and building outlines and overall dimensions as well as tie-in dimensions and clearances shall be clearly indicated.

The Bidder will be required to furnish all the necessary drawings data, etc. of the plant/equipment with appropriate 'status' stamp in adequate number of copies as indicated below.

Sr. No	Status of the drawing/document etc.	No. of copies for Purchaser	No. of copies for Consultant
1.	Reference/information	2 prints	2 prints
2.	For approval	2 prints	3 prints
3.	Final & certified duly signed	4 prints & 1 reproducible tracing/sepia & soft copy in CD	2 prints
4	Operation & maintenance manual	3 copies + CD	1 CD
5	Performance & acceptance test procedure	2 copies	2 copies
6	All other documents	3 copies	2 copies
7	As built drawings for the entire project	3 copies	1 copy

Within a period of ten (10) days after the receipt of those drawings/document, the Purchaser/Consultant shall signify his approval or otherwise. The Bidder shall submit copies of all drawings which are

required to be approved by the Purchaser/Consultant. The drawings which are approved by the Purchaser/Consultant shall not be deviated from.

The drawings submitted by the Bidder for approval shall contain all information regarding the manner in which equipment is going to be located and all the loading data, civil design for suitable civil foundation. The drawing should show details of piping and electrical connections to be made by the Purchaser/Consultant for connecting the Bidder's equipment in the system.

The operating & maintenance instruction and the erection procedures together with drawings of the equipment as completed shall be in sufficient detail to enable to Purchaser to properly erect/install the equipment, to maintain, dismantle, reassemble and adjust all parts of the equipment.

The manuals shall give stop-to-step procedures for all operations likely to be carried out during the life of the plant/equipment including during erection, commissioning, testing, operation & maintenance, dismantling and repair.

The manuals shall also contain copies of approved drawings as well as the performance/rating curves and copies of test certificates, if applicable. The maintenance instructions shall include the lubrication procedures, periodicity of lubrication as well as the brands of Indian lubricants to be used to ensure trouble free operation.

Indicative list of drawings to be submitted are given below. The final list including classification for information / approval will be frozen during the kick-off meeting. Apart from the below list, overall plant GA, overall electrical SLD, integrated plant piping, P & IDs for raw water, treated water, compressed air & cooling water, design basis, design of main boiler steel columns, etc. will be submitted for approval.

4.3.2 Tentative list of Drawings / documents to be submitted for steam generator

Sr. No.	Item
1)	P & I Diagram Steam and water system
2)	P & I Diagram Plant steam system
3)	P & I Diagram De-aerator, FWPS & Dosing System
4)	P & I Diagram Air & Flue gas system
5)	P & I Diagram compressed air system
6)	P & I Diagram cooling water system
7)	Boiler performance data sheet
8)	Sizing Calculation for Boiler feed pump (for both capacity & head)
9)	Sizing Calculation for Boiler feed water transfer pump
10)	Main steam line pressure drop calculation
11)	Piping line list
12)	Thermal insulation schedule (for piping & boiler)
13)	Valve Schedule
14)	Technical specifications for FD Fan
15)	Technical specifications for SA Fan

Sr. No.	Item
16)	Technical specifications for ID Fan
17)	Technical specifications for Boiler feed pump
18)	Technical specifications for Boiler feed water transfer pump
19)	Technical specifications for ESP
20)	Technical specifications for Soot Blowers
21)	Technical specifications for CBD valve
22)	Technical specifications for IBD valve
23)	Technical specifications for Boiler safety valve (Drum & SH)
24)	HP dosing system
25)	LP dosing system
26)	Control valve Data Sheet
27)	Gate, Globe, Check valves
28)	Drum level gauge
29)	GA Plan (Combined with elevation)
30)	Main foundation Drawing
31)	Auxiliary foundation Drawing
32)	Terminal point drawing
33)	Design basis for boiler structural
34)	De-aerator Assembly
35)	General Arrangement Drawing of Piping
36)	EQUIPMENT GA DRAWING
	a) ESP with loading data
	b) FD Fan
	c) SA Fan
	d) ID Fan
	e) LRSB
	f) Rotary Feeders
	g) Boiler feed pump
	h) Feed water transfer pump
	i) De-aerator
	j) Feed water tank
	k) CBD tank
	l) IBD tank
37)	ELECTRICAL & INSTRUMENTATION
38)	Single line diagram of boiler & all equipment in scope
39)	Power & Control wiring for different types of feeders
40)	Cable tray & trench layout for the boiler
41)	Cable tray & trench layout for the ESP system
42)	Earthing layout drawing for the complete equipment in scope
43)	MCC Panel Specification
44)	GA, schematic and wiring diagrams of VFD panels
45)	Logic diagrams for drives

Sr. No.	Item
46)	Control schematics
47)	Hook up drawings
48)	Logic diagrams for soot blower system
49)	Instrument cable tray routing drawing
50)	Electrical load list
51)	Cable schedule
52)	Instrument schedule (List only)
53)	DCS I/O list
54)	Alarm set point list
55)	Write up for control schematics
56)	JB schedule
57)	Sizing calculations for flow elements
58)	Motorized Valve Data Sheet.
59)	Actuator specs
60)	Instrument erection hardware details
61)	Flow elements
62)	Fire fighting system drawings for entire fire water piping, lube & control oil system, fuel handling system and BOM
63)	Contract co-ordination procedure
64)	L2 Schedule
65)	Milestone activities
66)	Utility Requirement data
67)	Specification for Motorized valves
68)	Electrical Motor Selection

4.3.3 Tentative Drawings / documents to be submitted for Fuel & ash handling

Sr. No.	Item
1)	Material of construction for all components
2)	Make, type and details for bought out items
3)	Overall assembly drawings for the equipment
4)	Layout for the handling system
5)	Equipment Size / Power / Belt Selection Calculation
6)	Overall assembly drawing showing the drive arrangement, etc. for each equipment
7)	Calculations for the select structure
8)	Copy of material certificates/ inspection reports
9)	Logic diagram / wiring diagram
10)	Layout drawings for the total fuel & ash handling system and for the equipment supplied

4.3.4 Drawings and documentations for Electrical distribution

The drawings and documents to be furnished by the select vender shall include but not limited to the following:

<u>Sr. No.</u>	<u>Item</u>	<u>Approval of Category</u>
I	General	
1.	Detailed bar chart for the design, manufacture, delivery, erection, testing and commissioning period with critical milestone activities	Approval
2.	Duly filled technical data sheets	Approval
3.	Single line diagram for the complete system, including 110 V, DC power distribution system	Approval
4.	Proposed hook-up arrangement drawings for plant, with layout plan and sections	Approval
5.	Physical installation layout of the complete plant, to show all electrical equipment in scope	Information
6.	Earthing layout for the Cogen plant	Approval
7.	Earthing connection details	Approval
8.	Earthing sizing calculations	Approval
10.	Cable schedule and inter connection chart for complete cabling in scope	Approval
11.	Cable tray / trench layout drawings, duly marking all the cables with identification details	Approval
12.	Cable tray and support arrangement drawings	Information
13.	GA drawings, catalogues and wiring diagrams, as applicable, for the items like capacitor banks, lighting fittings, lighting poles, junction boxes, receptacles, lighting and small power distribution boards, safety appliances, etc.	Information
14.	Any other drawings / details, as required for CEIG and other statutory authorities	Information
15.	Quality Assurance Plan	Approval
16.	List of manufacturers and specifications of all standard equipment	Approval
17.	Test certificates and inspection reports of all equipment	Information
18.	Erection manuals and installation procedures for all equipment	Information
	Operation and maintenance manuals for all equipment and systems	Information
19.	'As-Built' drawings	Information
VII	DC System	
1.	GA and wiring diagrams of Battery Charger	Approval
2.	Battery sizing calculations	Approval
3.	Dimensional details of battery banks	Approval
VIII	Illumination System	
1.	Lighting layout to show main lighting distribution board, lighting transformers, sub distribution boards, MCB distribution boards and lighting fittings with identification numbers	Approval
2.	Single line diagram with identification details for all lighting	Information

<u>Sr. No.</u>	<u>Item</u>	<u>Approval of Category</u>
	fittings	
3.	Lighting calculations for the complete system	Approval
4.	Typical drawings for poles, towers and other mounting arrangements	Approval

4.3.5 Tentative List of Drawings for balance of plant

Sr. No.	Item	Category of Approval
1.	PID for cooling water	Approval
2.	PID for raw water	Approval
3.	PID for WTP and DM water	Approval
4.	DCS architecture	Approval
5.	Cogen plant control logics	
6.	PID for compressed air	
7.	PID for yard steam piping upto terminal points	Approval
8.	PID for slop	
9.	GA of air compressor	
10.	GA of WTP	
11.	Plant layout	Approval

CHAPTER – 5

DATA SHEETS

Bidders to fill in the values and not refer to other documents

5.1 STEAM GENERATOR & AUXILIARIES

Sr. no.	Parameters	Value
1.	M.C.R with slop (TPH)	
2.	Pressure at turbine inlet valve kg/cm ²	
3.	Temperature at turbine inlet valve	
4.	Pr. at boiler MSSV	
5.	Temp. at boiler MSSV	
6.	Feed water temperature at deaerator inlet °C (minimum) (required minimum of 30°C)	
7.	Feed water temperature at deaerator outlet °C	
8.	Temperature of flue gases at the boiler outlet at MCR on slop	
9.	Coal consumption at MCR condition, with 9 TPH slop firing	
10.	Auxiliary power consumption, KW at 100% MCR	
11.	Capacity of agitated and steam heated boiler slop tank	
12.	Capacity and head of slop feed pumps (1W + 1 S/B) with VFD	
13.	Steam Drum	
14.	Material Specification	
15.	ID mm	
16.	Plate thickness mm	
17.	Length mm	
18.	Holding capacity m ³	
19.	Furnace Water Wall tubes	
20.	Tube OD mm	
21.	Thickness mm	
22.	Pitch mm	
23.	Material specification	
24.	Heat transfer area m ²	
25.	No. of passes	
26.	Ash hopper and RAV details	
27.	Evaporator Tubes	
28.	Arrangement	
29.	Tube OD mm	

Sr. no.	Parameters	Value		
30.	Material			
31.	Heating surface m ²			
32.	Ash hopper and RAV details			
33.	Precautions for erosion at entry			
34.	Boiler Headers			
35.	Diameter OD mm			
36.	Thickness mm			
37.	Material specifications			
38.	Superheaters			
39.	Type of superheater arrangement			
40.	Location of superheater			
41.	Superheater elements OD			
42.	Superheater elements thickness			
43.	Material			
44.	Heat transfer area			
45.	Type of attemperation			
46.	No. of stages			
47.	Turndown ratio			
48.	Precautions for erosion at entry			
49.	Ash hopper and RAV details			
50.	Furnace (effective)			
51.	Length of furnaces			
52.	Width of furnaces			
53.	Furnace area			
54.	Heat release rate			
55.	Material of grate bars			
56.	FEGT at MCR, Deg C			
57.	Furnace residence time, seconds			
58.	Economiser			
59.	OD of coil tube			
60.	Thickness of coil tube			
61.	Heating surface			
62.	Precautions for erosion			
63.	Ash hopper and RAV details			
64.	Air Preheater			
65.	Air preheater tube dia			
66.	Air preheater tube thickness			
67.	Tube material specification			
68.	Total heating surface			
69.	Heating medium			
70.	Total HTA (m²)			
71.	Pressure parts (effective)			
72.	HRU			
73.	Fans technical parameters	ID	FD	SA

Sr. no.	Parameters	Value		
74.	Nos. of fans per steam generator nos.			
75.	Capacity of the fan cu.m/sec(each)			
76.	At MCR kW(each motor)			
77.	Recommended drive motor kW			
78.	Electrical driven FWP			
79.	Nos. of pumps			
80.	Capacity			
81.	Head			
82.	VFD for motors			
83.	Drive power kW			
84.	Deaerator Flow rate(m ³ /hr)			
85.	Deaerator storage tank (m ³)			
86.	ESP			
87.	Volume of ash collection chamber before ESP			
88.	Ash hopper and RAV details for ash chamber			
89.	Inlet dust concentration			
90.	Gas flow			
91.	Outlet dust concentration			
92.	No. of fields			
93.	Ash hopper and RAV details for ESP			
94.	VFD for ID & FD fans			
95.	VFD for fuel feeders			
96.	Gas Velocity			
97.	- Furnace			
98.	- Evaporator bank			
99.	- Superheater			
100.	- Economiser			
101.	- ESP			
102.	No. & type of soot blowers			
103.	Pressure & temperature of steam to soot blowers			
104.	Capacity of coal silo			
105.	Hot / cold ducting thickness			
106.	Hot air / flue / cold air velocity, m/sec			
107.	Aluminium cladding thickness			
108.	Inclusion of steam flow meters			
109.	Type of combustion system			
110.	Inclusion of performance test as per ASME PTC 4.1, indirect method			
111.	Inclusion of Scope of Work and Terminal points / Battery limits as per tender / MoM, if any.			
112.	Commissioning of the plant & equipment within battery limits in 12 months period			

5.2 BALANCE PUMPS

•	Slop Transfer Pumps from receiving tank to boiler		
•	Nos.		1 +1
•	Type	:	SS304
•	Capacity	:	
•	Discharge head	:	
•	Make	:	
•	Pumps for cooling water circulation to condenser and turbine auxiliaries	:	2 nos (1W + 1S/b)
•	Service	:	Cooling water circulation
•	Discharge head	:	30m
•	Capacity	:	900 m ³ /hr
•	Material of construction	:	Bronze
•	Pumps for service water	:	2 nos (1W + 1S/b)
•	Service	:	For CT make up and other requirements in scope
•	Discharge head	:	As required
•	Capacity	:	25 m ³ /hr
•	Material of construction	:	Bronze

5.3 PERFORMANCE GUARANTEE

Sr. No.	Parameters	Value
1.	Time period from notice to proceed up to commissioning trials	
2.	Steam generation at rated parameters with 9.25 TPH slop and support fuel (Coal and bagasse), please specify quantity of required both support fuels.	
3.	Guaranteed auxiliary power for entire scope, KWH	
4.	Performance test code for steam generator & auxiliaries	
5.	Performance test code for all other equipments, including air compressor, material handling, water treatment etc.	As per relevant IS codes for specified capacity, turndown, guaranteed auxiliary

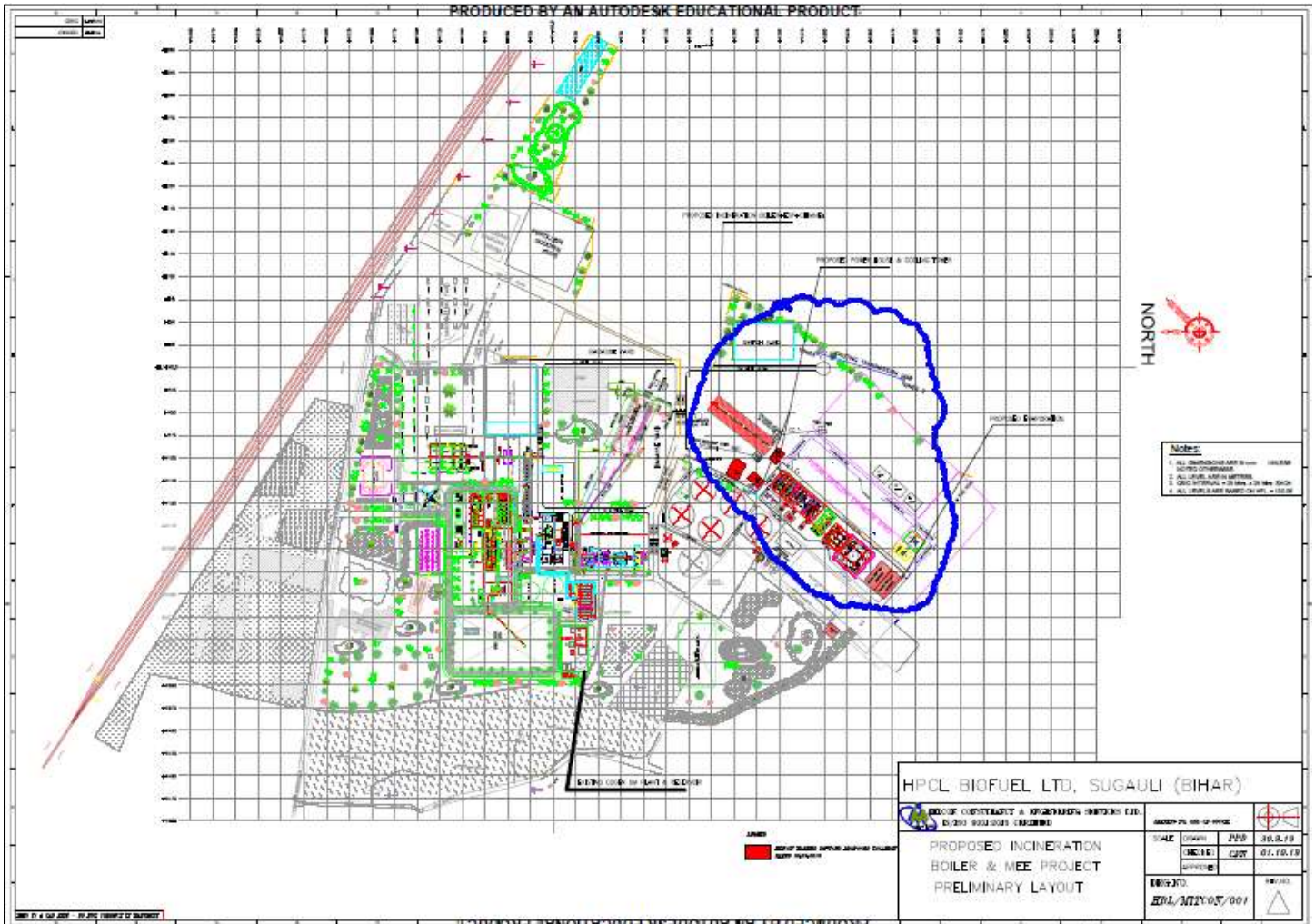
Sr. No.	Parameters	Value
		consumption, noise levels and specified output qualities
6.	Minimum frequency of boiler shut down for cleaning, days	
7.	Duration of performance test (to be carried out by the Bidder with calibrated instruments within 3 months of commissioning)	Individual equipment will undergo performance test as per relevant standard and in the minimum to document the continuous availability of rated output and efficiency. The cogeneration power plant as a complete system will undergo performance test for a period of 7 continuous days to prove reliability and capacity of all sub-systems. Within this period, individual PG tests of main power island will be carried for a minimum period of 8 hours, as per relevant code. PG test will also demonstrate auxiliary power consumption.

5.4 LIST OF TECHNICAL DEVIATIONS, IF ANY

Clause no. & Page no,	Details as per tender	Deviation required by Bidder	Reply on sought deviations by Consultant to all bidders

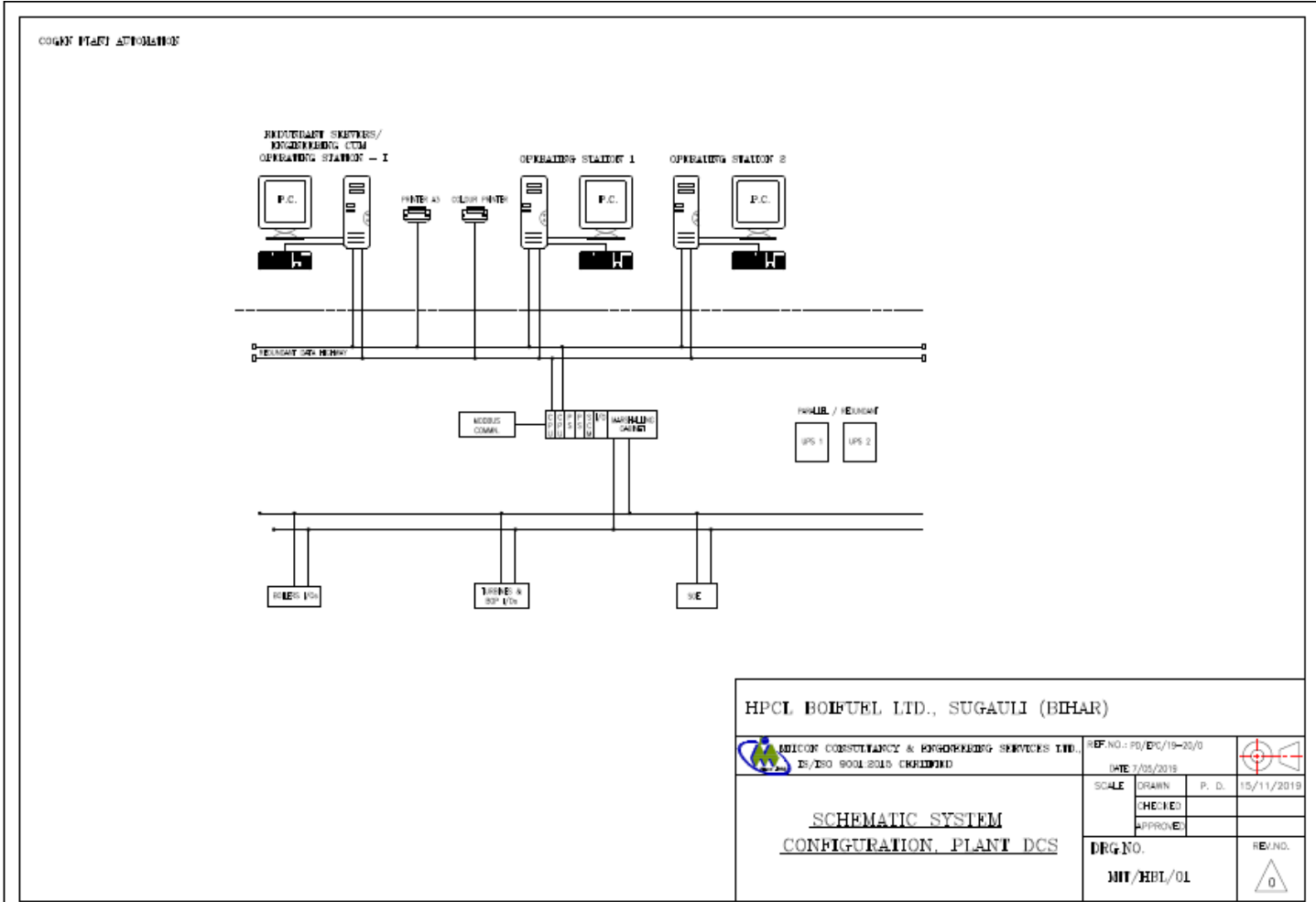
APPENDIX –I

PLANT LAYOUT FOR SUGALI SITE



APPENDIX II

DCS CONFIGURATION



APPENDIX – III

PIPING AND WELDING PROCEDURE

1 Design Requirements

- 1.1 The equipment and work under this specification shall conform to the following standards / codes:
- a. Indian Boiler Regulations.
 - b. Applicable Standards for Structural Steel.
 - i. IS:800 : Codes of Practice for use of Structural Steel in general Building Construction.
 - ii. IS:2062: Structural Steel (Fusion Welding Quality)
 - c. American National Standard ASME code for "Power Piping " - ASME B 31.1 and all other associated ASME Standards.
 - d. American Society of Testing and Materials (ASTM) Specifications.
 - e. American Society of Mechanical Engineers (ASME) Codes.
- 1.2 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 clearances shall be ensured with respect to the above to accommodate insulation and pipe movements.
- 1.3 All piping shall be grouped where practicable and shall be routed to present a neat appearance.
- 1.4 The piping shall be arranged to provide clearance for the removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance.
- 1.5 Wherever pipes are to be bent, the bends shall be free from wrinkles and bulges. The bends shall be made by cold bending.
- 1.6 Overhead piping shall have a minimum vertical clearance of 2.3 meters above walkways and working areas and 6 meters above roadways
- 1.7 Drains shall be provided at all low points and vent at all high points as per actual layout regardless of whether the same have been shown in the flow diagrams are not. Pipelines shall be sloped towards the drain points.

- 1.8 Provision shall be made while preparing piping layout to accept control valves, flow measuring elements and any other on line speciality or equipment supplied by others. Sufficient upstream and down stream lengths shall be provided for flow measuring devices, control valves, desuperheaters and other specialities as required by the Suppliers.
- 1.9 At all screwed valves and screwed connections on equipment, unions shall be provide to facilitate disassembly. Likewise, unions shall also be provided at suitable points on straight lengths of screwed pipelines.
- 1.10 All local instruments shall be located on pipelines as to render them observable from the nearest available platforms and accessible for maintenance.
- 1.11 Piping with operating temperatures above or below the ambient shall be routed so as to provide adequate flexibility for the pipes.
- 1.12 All steam tracer lines shall be provided with expansion loops to take care of differential expansion between the tracer and main line.
- 1.13 Pipelines of NB 40 size and below are regarded as field run piping.
- 1.14 All pipe to pipe joints shall be by butt welding only and no couplings shall be used.
- 1.15 All flanges of pressure class 300 and less than 900 shall be of weld neck type. For class 900 and above the flanges shall be WNRTJ type.
- 1.16 Pipe fittings like elbows, equal tees and reducers shall be as given below:
- a) For pipe size 50 NB and above shall be butt welded type.
 - b) For 40 NB and below shall be socket welded type.
- 1.17 Branch connections:
- Equal Branch:
- a) NB 50 & Above - BW equal tee as per ASME B 16.9
 - b) NB 40 & Below - SW equal tee as per ASME B 16.11
- Unequal Branch:
- a. Branch upto NB 40 SW half coupling as per ASME B 16.11 to be used, for run pipe size NB 50 and above.
 - b. Branch NB 50 and above, branch piping with suitable reinforcement shall be used. However no reinforcement pads shall be used for applications with design temperature exceeding 300 Deg.C.
 - c. Equal tee with reducing coupling or reducer to be used for run size NB 40 and below.

- d. No branch welding shall be used for equal branch, and only tees as per ASME B 16.9 or ASME B 16.11 to be used.
- 1.18 All pressure tappings for pressure applications above 40 Kg/Sq.Cm shall be of size NB 25 with two root valves. For pressures 40 Kg/Sq.Cm and less the size shall be NB 15 with one root valve. For temperature above 400°C irrespective of pressures, the root valve size shall be NB 25.
- 1.19 All thermowell boss shall be one(1) inch NPT.
- 1.20 Pipe Sizing and Layout
- 1.20.1 The design of the piping system shall be based on the ASME B31.1 code. In addition the statutory requirements of the IBR shall also be taken care of wherever required. Flexibility analysis shall be made for all piping systems with operating temperatures above 100 Deg.C. The correct locations of hangers and supports, with as applicable spring stiffnesses , shall be considered for the flexibility analysis. Suitable expansion loops, restraints and anchors shall be provided so as to ensure compliance with the applicable codes and to limit the stress and reactions to within the allowable values.
- 1.20.2 All piping shall be sized considering the allowable velocity and allowable pressure drop in the system. The indicative flow velocities in pipes shall be limited to the following values. However, if the available pressure drop are to be maintained, the piping system may have to be selected even with a lower velocity than the minimum indicated.
- 1.20.3 Drains at all low points and vents at all high points shall be provided. Drain size shall be minimum NB 25 and for saturated steam lines the drain size shall be NB 40. Vent size shall be NB 20 for pressures 40 Kg/Sq.Cm and above, and NB 15 for pressures below 40 Kg/Sq.Cm.
- 1.20.4 All local instruments shall be located on pipelines so as to render them observable from the nearest available platform.
- 1.20.5 The boiler feed water piping downstream of the Boiler feed water pumps and upto the feed check and stop valve shall be designed for the cold shut off pressure of the boiler feed water pumps.
- 1.20.6 All pipes of size NB 50 & below shall be minimum Schedule 80 thickness for all steam and feed water applications
- 1.21 Materials
- 1.21.1 Pipe materials for various services and materials for fittings, flanges, fasteners shall not be inferior to the specifications given below. All piping except, for cooling water, raw water, safety and relief valve exhausts, vents and air services shall be of seamless steel. For cooling water, raw water and air services the piping could be of ERW.
- 1.21.2 Piping for services with metal temperatures equal to or greater than 400 Deg.C and less than 510 Deg.C, 1 1/4% chromium, 1/2% molybdenum ferritic alloy steel seamless pipe as per ASTM A-335

P-11 or P12. Piping for services with metal temperatures higher than 510°C shall conform to the specifications of ASTM A-335 P22 (2¼ chromium 1 molybdenum steel) or its equivalent.

- 1.21.3 Piping for services at temperatures less than 400 Deg.C for steam, boiler feed, condensate, drain piping etc., carbon steel piping as per ASTM A-106 Grade B.
- 1.21.4 HP and LP chemical dosing system: Stainless Steel to SA 312 TP 304 specifications.
- 1.21.5 Other Services: Carbon Steel Piping as per ASTM A-106 Grade B.
- 1.21.6 For the safety valve exhaust piping, where the exhaust steam temperature is less than 400 Deg.C, the piping material shall be API 5L Gr.B.
- 1.21.7 For cooling water and raw water applications the piping material shall be IS 1239 Black Heavy Class for size upto NB 150 and as per IS 3589 for size NB 200 and above.
- 1.21.8 For Service air applications the piping shall be IS 1239 Black Heavy Class.
- 1.21.9 For instrument air applications : IS 1239 GI pipes.
- 1.21.10 For piping system where IS1239 or 3589 pipes are used, the fittings shall be as per A 234 as per ASME B 16.9 and ASME B16.11. All flanges shall be as per ASME 16.5.
- 1.21.11 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 with the material it purpose to certify. The heat number shall also be indicated on the material certified.

1.22 Fabrication and erection

- 1.22.1 Pipelines having size NB 40 mm and below are deemed field run and are hence fabricated in site. For bends, only socket weld elbows to be used.
- 1.22.2 All welded attachments on pipelines shall be of same material as the parent pipeline and shall be subjected to the same fabrication and welding procedures as the associated piping.
- 1.22.3 The use of companion flanges to connect two pieces of pipe and the use of odd or short pieces of pipe in making up long runs is prohibited.
- 1.22.4 Where welded pipe or fittings are used, longitudinal welds in adjoining sections shall be staggered to a minimum of 90 degrees during fabrication. All piping shall be fabricated true to lines and elevations as indicated on the piping drawings.
- 1.22.5 Bends in seam welded pipe shall be oriented so that the seam is positioned along the neutral axis.
- 1.22.6 No welding shall be carried out on lined pipes.

- 1.22.7 Gas cutting for bolt holes including for U-clamp supports shall be prohibited.
- 1.22.8 Neither butt nor branch joints shall be closer than twice the pipe diameter to any other joint in the same pipe except where "weldolet" type fittings are used in which case the branch weld must be made to the "weldolet".
- 1.22.9 All pipe bends, where the pipe diameter is NB 65 and above shall have a radius of five nominal pipe diameters. The pipe bends shall be true to angle and radius and shall maintain a true circular cross section of pipe without deformity or undue stretching. Crimping of pipes to form bends is not acceptable. Only cold bending which does not require stress relieving operation, may be carried out at site. Any bending requiring preheating has to be done only at shop. Cold bending shall be done using pipe bending machine (manual or electric). Bends shall be free from wrinkles and bulges.
- 1.22.10 All threads on piping components shall be taper pipe threads as per applicable standards.
- 1.22.11 The first circumferential weld joint after a pipe bend shall be after a minimum straight length of two times the pipe diameter or 500 mm, whichever is less.
- 1.22.12 No external support shall be welded on valves and specialties except as provided by the Manufacturer.
- 1.22.13 Welding ends for butt-welding shall be as per Standard V-bevel with an included angle of 75 degrees.
- 1.22.14 All pipe flanges and contact surfaces shall be concentric with the axis of the piping. All flanges and fittings shall be accurately machined and drilled true to the template.
- 1.22.15 No welding / gas cutting shall be done locally to valves with soft seating components in order to prevent distortion of the soft seats.
- 1.22.16 All stub and other attachment to be welded on the piping system shall be carried out in the shop or in pre-fabrication yard and only insitu butt welding alone will be carried out.
- 1.22.17 Welding and Non-destructive examination
- a. Welding, non-destructive examination of welded joints and repair of weld defect areas shall conform to Clause No.3.15.9, "Welding Specification for Fusion Welded Piping Systems".
 - b. Final welding of joints shall be undertaken only after the set up of piping is fully checked with respect to layout drawings.
 - c. At equipment terminal points, welding shall be carried out after taking into account specific requirement and / or recommendations of the equipment supplier.
- 1.22.18 Cleaning, & blow-out
- a. All piping including valves and specialties shall be cleaned by the **SUPPLIER** before and during erection to remove grease, dirt, dust scale and welding slag.

- b. Before erection all fabricated pipework, assemblies, sub-assemblies, fittings and components etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes. The brushes shall be of the same or similar material as the metal being cleaned.
- c. After erection, all steam water and condensate lines shall be mass flushed with water. The cleaning velocities in water and condensate lines shall be 1.2 to 1.5 times the operating velocities in the pipelines. Use may be made of standby pumps wherever available for the purpose.
- d. All compressed air pipework shall be cleaned by blowing compressed air.
- e. All fuel oil, tight oil and lubricating oil lines shall be cleaned by pickling. Alternately, these lines can be cleaned by steam blowing subject to the timely availability of steam for this purpose.
- f. All auxiliary steamlines shall be steam blown to effectively remove scale and slag.

1.22.19 Material

- a. Chemical Composition
- b. Mechanical properties such as tensile, flattening, bending, impact etc. as called for in the respective material specification standards.
- c. Heat treatment in the case of pipes used for steam service.
- d. Dimensions.
- e. Hydrostatic Tests.
- f. IBR approved Certificates.
- g. NDT Reports.
- h. Reports on Visual Examination.

1.23 Hangers and supports

1.23.1 All equipment covered under this specification shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

1.23.2 It is desirable that supports should as far as practicable, be arranged adjacent to the pipe joint.

1.23.3 Constant load hangers / spring hangers shall be provided wherever necessary for critical piping systems such as main steam piping and boiler feed delivery piping. The variation between hot and cold loads, if variable spring hangers are used, shall not exceed $\pm 25\%$ of the rated load.

- 1.23.4 Lugs and additional structural members should be suitably welded to the pipes wherever necessary for hangers and restraints.
- 1.23.5 All bare pipes on racks and sleepers shall be clamped at intervals of at least 2 M.
- 1.23.6 Pipe clamps shall have a minimum thickness of 6 mm.
- 1.23.7 All rigid hangers shall provide a means for vertical adjustments after erection.
- 1.23.8 All components of hangers which move relative to the pipe during expansion shall be connected to the pipe clamps or lugs in such a way that these parts are outside insulation.
- 1.23.9 Vertical pipes near tanks should be supported from pad plates already provided on the tank shell.
- 1.23.10 All vertical lines shall be properly supported on the vertical run and additionally provided with adequate number of lateral restraints where the length of vertical run exceeds 5 M.
- 1.23.11 Except for small bore lines, pipes should not be supported from brick walls.
- 1.23.12 In selecting position and type of hangers, **SUPPLIER** shall endeavor to layout the work such that pipe load stress imposed on the supporting steel are kept to minimum.

1.24 Valves

1.24.1 General Technical Requirement

- All valves shall be suitable for the service conditions i.e. flow, temperature and pressure, at which they are required to operate. Valves performing similar duties and of same size, rating, material and type shall be interchangeable with one another.
- 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.
- All gate valve shall be of full-way / reducing bore type, when in the full open position, the bore of the valve shall not be constricted by any part of the gate.
- All globe valves of size NB 50 and below shall be of integral type.
- Reconditioning of seating surface shall be possible without removing the valve body from the line.
- All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel.
- All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening / closing can be readily determined.
- Manually operated valves shall be provided with gear operator of proven quality conforming to some

Internationally accepted Standard and Make if the torque required to operate the valve exceed 13.8 kg.M.

- Integral bypass valve shall be provided for valves of size NB 250 and above with pressure class rating 300, 400 and 600. Integral bypass valve shall be forged gate or globe valve socket welded to ASME B 16.11. The material of integral bypass valve shall be SA 105.
- The pipe used for mounting the integral bypass valve shall be seamless to SA 106 Gr.B and minimum schedule 80 thickness.
- Integral bypass valve shall be provided for valves of size NB 100 and above with pressure class rating 900 and above. Integral bypass valve shall be forged gate or globe valve socket welded to ASME B 16.11. The material of integral bypass valve shall be A 182 F22. The pipe used for mounting the integral bypass valve shall be seamless to A 335 Gr.P22 and minimum schedule 80 thickness.
- Bypass valves shall be motor operated, if the main valve is motor operated.
- When globe valves are provided as integral bypass valve, the direction of flow of fluid must be marked on the body of the main valve by stamping or embossing.
- Integral bypass valve shall be supplied in the condition of “As welded” with the main valve. The size of the valve shall be minimum NB 25.
- All globe valves shall be of vertical stem type. The construction of globe valves shall facilitate for easy disassembly of the internals (stem and disc).
- The body, seat shall be inclined at such an angle from the vertical so as to facilitate closing and to prevent chattering for check valves.
- Direction of flow shall be marked on the body of globe valve and check valve.
- Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion. All valve end connections shall suitably be protected to prevent damage and entry of dirt till erected.
- The valves as well as all accessories shall be designed for easy disassembly and maintenance. End to end dimensions shall be in accordance to ASME B 16.10 or as per respective codes.
- All valves under the purview of IBR shall be provided with IBR certificate.
- No asbestos or cadmium based material shall be used.
- All sampling and root valves furnished shall be of integral body bonnet type.
- Y type globe valves are not acceptable.

- Locked open type valves shall be provided for the following:
 - Isolation valve in ARC bypass line to deaerator
 - Isolation valve in Feed water transfer pump minimum recirculation valve
 - Isolation valve in the upstream of electromagnetic safety valve
 - Isolation valve in the soot blowing steam tap off from superheater

1.24.2 Both the continuous blow down valve and the intermittent blowdown valves shall be of angle type and shall be provided with motor actuators. Manually operated angle valves shall be provided as a bypass to the motorised valves.

1.24.3 All gate valves with pressure seal bonnet and used for steam application shall be provided with suitable bonnet relieving device.

1.25 Welding specification for piping system

1.25.1 Scope

1.25.2 This specification shall apply to all welded pipe joints of carbon and alloy steels including stainless steels for power plant piping system. This specification is applicable to shop fabrication, site fabrication & field erection. The welded joints are hereby defined as including:

1.25.3 All the line joints of the longitudinal and circumferential butt-welded and socket welded type.

1.25.4 All the attachment of castings, forgings and flanges to pipe.

1.25.5 Welded manifold headers and all other sub-assemblies.

1.25.6 Welded branch connection with or without saddles and reinforcement rings.

1.25.7 Fabrication of built-up fittings.

1.25.8 The attachment of smaller connections for drips, drains, instruments, branch lines, weldolets, sockolets, thermowells, couplings etc.

1.25.9 Closure of joints for inspection plugs and similar joints.

1.25.10 Any other similar joint not specified above but encountered during fabrication and / or erection stage. It is imperative that the CONTRACTOR makes every effort to secure the same high degree of competent supervision and workmanship during field erection as is intended for shop fabrication in view of the adverse field conditions of weather, piping location etc.,

1.25.11 The piping systems are generally classified as follows:

1.25.12 Alloy steel piping system for temperature above 400° C and all pressures.

- 1.25.13 Carbon steel piping system for temperature 400° C and below and pressure over 71Kg/sq.cm.
- 1.25.14 Carbon Steel piping system for temperature over 218° C and less than 400° C and pressure over 17 kg/sq.cm(g). and upto 71 kg/sq.cm(g).
- 1.25.15 Carbon steel pipe system for temperature 218° C and less and pressure 17 kg/sq.cm(g) and less.
- 1.25.16 Stainless steel piping.
- 1.25.17 Material specification for the above systems are generally covered by the following.
- 1.25.18 Alloy steel piping

Ferritic alloy steel pipes to ASTM A335 Gr.P11, P12 & P22, A691 Gr. 11, 12 & 22 or equivalent and corresponding materials for fittings, flanges, valves etc.,

1.25.19 Carbon Steel Piping

Carbon Steel Piping to ASTM A 106 Gr. A, B, C, ASTM A 53 Gr. A, B, IS 1239, API 5L Gr. B, ASTM A 672 Gr. B60 C1.22, IS 3589, IS 2002 Gr. 2A. or equivalent and corresponding materials for fittings, flanges, valves etc.

1.25.20 Stainless Steel Piping

Stainless Steel Piping to ASTM A 312 TP 304, 316 etc. or equivalent and corresponding materials for fittings, flanges, valves etc.,

1.25.21 Codes and Standards

The welding of fusion welded piping system shall comply with currently applicable regulations, codes and safety codes in the locality where it will be installed. It shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the **SUPPLIER** of this responsibility. In particular, the pipe welding shall conform to the latest edition of the following codes and standards.

1.25.22 ASME codes for power piping - ASME B 31.1.

1.25.23 Indian Boiler Regulation - IBR

1.25.24 ASME Boiler and Pressure Vessel Codes -

Section I – Rules for construction of Power Boilers
Section II Part A – Ferrous material specifications,
Section II Part C – Specifications for welding rods, electrodes & fillet
metals
Section V – Non destructive examination

Section VIII – Rules for construction of pressure vessels
Section IX – Welding & Brazing qualification

- 1.25.25 Specification of the American Welding Society.
- 1.25.26 Standards of Pipe fabrication Institute.
- 1.25.27 BS 2633 specification for Class I arc welding of ferritic steel pipe work for carrying fluids.
- 1.25.28 Any other codes and standards which are required to perform the specified welding.
- 1.25.29 The above mentioned codes and standards form an integral part of this specification. In the event of conflict between this specification and the codes and standards listed above, this specification shall govern.

1.25.30 Welding Process

The welding process that are used in the fabrication of pipes and fittings are restricted to shielded metal arc welding and gas tungsten arc welding (argon arc) or a combination of the two.

Argon arc root pass shall be employed for all alloy steel, carbon steel piping and stainless steel piping system. Subsequent welding, after root pass can be carried out by manual shielded metal arc welding with coated electrodes. For pipes of wall thickness less than 6 mm, the entire welding shall be carried out by tungsten inert gas welding process. When using tungsten inert gas welding process, welding without addition of filler metal shall not be done.

For critical carbon steel piping system (Refer Exhibit-1 attached at the end of this section), the TIG root pass shall be employed and subsequent welding after root pass can be carried out by manually shielded metal arc welding with coated electrodes.

For Non-critical carbon steel piping system (Refer Exhibit-2 attached at the end of this section), the entire welding including root pass may be carried out by manual metal arc welding.

1.25.31 Procedure and Performance Qualification

No production welding shall be undertaken until the procedure qualification test which are to be used have been established as per ASME boiler & pressure vessel code Section IX and / or IBR. The test results and specimens from qualification test of the welding process and welding operators shall be made available to the **PURCHASER / CONSULTANT** for approval. Where results of existing procedure qualification and of welders are acceptable to the **PURCHASER / CONSULTANT**, such results shall be kept on file and be subject as to review regularly. Where doubt exists regarding the acceptability of any qualification test, a retest may be required. All such qualification tests and specimen testing shall be conducted in the presence of the **PURCHASER / CONSULTANT**.

The Cost of all procedure qualification test shall be borne by the **SUPPLIER**.

The **SUPPLIER** shall prepare a written specification containing the information detailed in Section IX of ASME form QW-482, 483 & 484 (WPS, PQR & WPQ). These documents shall be provided

to the **PURCHASER / CONSULTANT** for review and approval. The **SUPPLIER** shall prepare certificate of welder performance qualification test containing the information detailed in ASME Section IX. These shall be kept on file and made available to the **PURCHASER / CONSULTANT** upon request.

1.25.32 Welders and Supervisors

Welding supervisors shall have adequate qualifications and experience in supervising welding of pipe joints with knowledge of non-destructive testing.

All welding including the tacking of all welds shall be carried out by approved welders only. Any weld made by other than the unapproved welder shall be cut out and re-welded.

For the purposes of identification and to enable tracing the full history of each joint, records of weld completed by each welder has to be maintained by the **SUPPLIER** and records are to be handed over to the **PURCHASER / CONSULTANT**

For each welder, a record card shall be maintained showing the procedures for which he is qualified. These record cards shall be specified joint details, consumables and their repair frequency. The record shall be reviewed every fortnight by the **PURCHASER / CONSULTANT** and those welders whose work require a disproportionate amount of repair shall be disqualified from welding. Re-qualification of welders disqualified more than two times shall be entirely at the discretion of the **PURCHASER / CONSULTANT**.

1.25.33 Preparation of Weld Ends

The surfaces to be welded shall be smooth, uniform and free from fins, tears and other defect which would adversely affect the quality of weld. All weld faces and adjoining surfaces for a distance of atleast 150mm from the edge of the welding groove or 12 mm from the toe of fillet in the case of socket weld or fillet welded joints shall be thoroughly cleaned of rust, scale, paint, oil or grease both inside and outside. Both inside and outside of pipe ends shall be prepared for welding by painting with one (1) coat of deoxaluminat or equal for a length of 50 mm on either side of weld.

Unless otherwise specified, all pipe joints shall be butt-welded. All butt welds shall be full penetration welds. Wherever socket welding fittings are used, the connecting pipe will be socket welded.

1.25.34 Butt Joints

Butt joints shall be prepared as per ASME B 16.25 and / or IBR, unless otherwise specified. Half angle of the single V butt joints shall be 37.5 ± 2 Deg.

While meeting alignment of pipe joints as per ASME B 31.1 and / or IBR, care shall be exercise that the trimming depth in case of excess misalignment does not interface with Radiography / Ultrasonic (RT /

UT) interpretations. In such cases the trimming width from the tip of the edge preparation along the pipe shall be large enough that it is well away from the weld face.

Unless noted otherwise, all butt welds shall be made without using backing rings.

Tee, corner and lap joints

Fillet welds shall have a throat dimension equal to the nominal thickness of either of the joint members.

Weld edges of full penetration groove welds for Tee joints shall be prepared with minimum included angle of 45 Deg.

The ends shall be prepared by machining, grinding or flame cutting. Where flame cutting is used, the effect on the mechanical and metallurgical properties of the base metal shall be taken into consideration. Flame cutting alloy steel pipes is not allowed. However, flame cutting of carbon steel pipes is permitted. Wherever practicable, flame cutting shall be carried out by machine.

Thermal cutting of carbon steel piping shall be performed under the same conditions of preheat and postheat as for the welding of carbon steel material. However postheat is not required when:

The heat affected zone produced by thermal cutting is removed by mechanical means immediately after cutting. However in any case of removing, slag, scale or oxide shall be removed by grinding to bright metals atleast 2 mm beyond the burnt area, or,

Thermal cutting is part of fabrication, manufacturing or erection sequence leading to a weld end preparation where heating immediately follows.

All weld joint fit-up shall comply with the tolerances specified on the design drawings or applicable codes and standards.

1.25.35 Welding of Pipes

The maximum face width of any manual arc or inert gas weld run shall be as per standard as specified in ASME

No single run horizontal / vertical position manual metallic arc weld fillet shall exceed 8 mm in size.

Fillet welds shall have a throat dimension atleast equal to the nominal wall thickness specified for the pipe. Each leg of the fillet weld shall have a length of atleast 1.25 times in the nominal wall thickness of the pipe. Socket and fillet welds shall have a minimum of two (2) weld layers.

All tack welds shall be made using a qualified procedure and qualified welders. Any preheat requirement specified on the welding procedure shall also apply to tack welds.

All tack welds shall be examined visually for defects, and if found defective shall be completely removed.

As the welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their stopping and starting ends so that they may be satisfactorily incorporated in the final weld.

Welded-on branches for all piping systems shall be of full penetration type connection-welded.

Preheating prior to tack welding and welding shall be employed as a means of crack prevention and improving general weld reliability. At no time during welding, temperature of the joint shall not be allowed to fall below the minimum preheat temperature. Excessive preheating shall be avoided.

Irrespective of class of steel, root run shall be made without interruption other than for changing the electrodes or to allow the welder to reposition himself. Root runs made in the shop may afterwards be allowed to cool by taking suitable precautions to ensure slow cooling e.g. by wrapping in a dry asbestos blanket. Welds made at site shall not

be allowed to cool until the thickness of weld metal deposited exceeds 1/3 of the final weld thickness or 10 mm whichever is greater.

When welding alloy steel, it is strongly recommended that interruption of welding shall be avoided. Where such interruption is unavoidable, either the preheat shall be maintained during interruption or the joint shall be wrapped in dry asbestos blankets to ensure slow cooling. Before recommencing welding, preheat shall be applied again.

No welding shall be done if there is impingement of rain, snow, sleet or high wind on the weld area.

All the weld pieces shall be removed after welding of pipe joint and the weld area ground flush and subjected to Magnetic particle / Dye-penetrant examination before applying any post weld heat treatment. These pieces shall be welded by qualified welders and with electrodes compatible with the parent pipe material. The preheating requirements shall be applied and maintained during the welding of pieces. These temporary attachments shall be removed by grinding, chipping or flame gouging. When arc flame gouging is used at least 3.2 mm of metal shall be left around the pipe surfaces, which shall be removed by grinding.

The arc shall be struck only on those parts of the parent metal where weld metal is to be deposited. When inadvertent arc strikes are made on the base metal surfaces outside the joint groove, the arc strikes shall be removed by grinding and shall be examined by liquid penetration or magnetic particle inspection procedures.

Oxides shall not be permitted to form during welding or heat treatment or both on the internal surface of pipe, which will not be subsequently cleaned. Inert gas purging will be an acceptable method to prevent such oxidation. All joints in material which contain 1¼% or more chromium shall be purged to assure that less than 1% of oxygen is present on the joint under side before initiation of the welding. The purging operation may be terminated when 5mm thickness of weld metal is deposited into the joint.

Argon gas used in GTAW process for shielding and purging gas purity shall be minimum of 99.95 %. Purging shall be carried out at the flow rate depending on diameter of pipe until six (6) times of the

volume between dams is displaced. In no case shall the initial purging period be less than ten (10) minutes. After initial purging the flow of the backing gas shall be reduced to a point where only a slight positive pressure prevails. Any dams used in purging shall be fully identified and removed after welding and accounted for in order to avoid leaving them in the system.

Thorough check shall be exercised to maintain the required interpass temperature.

After deposition, each layer of the weld metal shall be cleaned with a wire brush to remove all slag, scale and defects to prepare for the proper deposition of the next layer. The material of wire brush shall be compatible with pipe material. Special care shall be taken to secure complete and thorough penetration of the fusion zone into the bottom of the weld. In case, where the weld joint on pipes 100 mm NPS and larger has to be radiographed as per the requirement of this specification, it is recommended that the root run be checked by liquid penetrant or magnetic particle procedures.

Gouging or back-gouging of butt welds may be carried out wherever feasible by grinding, chipping, machining or other approved methods, but the surface of cut must be cleaned to remove any carbon or oxidised metal before commencing the welding.

Repair of weld metal defects shall meet Cl. 127.4.11 of ASME B31.1 and / or IBR

Upon completion of welding, the joints shall be wrapped in dry asbestos blankets to ensure slow cooling unless post-weld heat treatment is applied immediately.

Except where necessary to grained flush for non destructive examination purpose, the centre of reinforcement for butt welds shall be as below.

Component Thickness (mm)	Maximum Reinforcement (mm)
Upto 12	1.6
Over 12 to 25	2.4
Over 25 to 50	3.2
Over 50	4.0

The reinforcement shall be crowned at the centre and tapered on each side of the joined members.

The exposed surface of the weld shall be ground where required to present a workman like appearance and shall be free from depressions below the surface of the joined members. The exposed surface of the butt welds shall be free from under cuts greater than 0.5 mm in depth, overlaps from abrupt ridges and valleys and shall merge smoothly into the pipe surface at the weld toe. However, undercuts shall not encroach on the minimum section thickness. Post weld heat treatment shall be carried out as per Cl. 132 of ASME B 31.1 and / or IBR

1.26 Identification of Welds

Whenever code symbol stamps are required on carbon steel and Ferritic alloy steel piping, they shall be applied directly to the pipe with low stress dotted design metal die stamps or to a small stainless steel

plate especially provided for such marks. These plate shall be lightly tack welded to the pipe using electrodes (of diameter 3 mm or less) of the type specified for the material. Before making the required tack

weld, the pipe material in the immediate surrounding area shall be preheated as required by electric means or propane or natural gas burners. Cooling shall take place under asbestos insulation in a draft

free area. Stress relieving of these welds are not required. Steel stamping directly on the surface of alloy steel piping with other than low stress die stamps shall not be permitted.

1.26.1 Seal welds

Seal welding shall be done by qualified welders and in accordance with approved drawings.

If necessary, threaded joints that are to be seal welded shall be made without the use of thread lubricating compound

1.26.2 Preheating

Preheating prior to tack welding and welding shall be employed as a means of crack prevention and to improve general weld reliability.

1.27 Carbon Steel

Welded joints in carbon steel piping where tensile strength is below 4900 Kg/Sq.Cm, the carbon content does not exceed 0.3% and thickness design exceed 19mm need not be preheated except where the ambient temperature is below 16° C. For this condition the joint shall be heated to 40° C before any welding is performed. When the thickness is 19mm and above, the preheating shall be performed as follows:

WALL THICKNESS (MM)	MINIMUM PREHEAT (° C) METAL TEMPERATURE
19 TO 38	100
38.1 TO 63	125
Above 63	150

Weld joints in carbon steel piping where the tensile strength is 4900 sq.cm or greater or where the carbon content exceeds 0.3%, When the thickness is 19mm and above, shall be preheated before any welding is performed according to the following requirement:

WALL THICKNESS (MM)	MINIMUM PREHEAT (° C) METAL TEMPERATURE
19 TO 38	125
38.1 TO 63	150
Above 63	150

At no time, during welding operation shall the temperature of weld area be allowed to fall below these temperatures. Before performing any tack welding which may be required in preparing carbon steel pipe for welding or other fabrication or before attaching thermocouples, the pipe area to which the tack weld is to be made shall be evenly heated to this temperatures preferably by resistance heating or induction coils. Propane or natural gas torches or preferably burner rings shall be employed where it is impossible to use electric heating. The use of oxy-acetylene gas is prohibited. The metal temperature in this procedure shall be determined by the use of thermocouples and potentiometers except that the temperature sensitive crayons shall be used as a temperature indicator in tack welding thermocouples. However, temperature indicating crayons may be used.

Weld joints for piping NB 100 and larger shall be heated by means of induction coils or resistance heating. Welded joints in smaller pipe shall be heated by means of electrical resistance coils or suitable propane or natural gas torches.

1.27.1 Alloy Steel

1.27.1.1 Weld joints in alloy steel piping shall be preheated before any welding is performed according to the following table.

MATERIAL	MINIMUM PREHEAT-METAL TEMPERATURE
1 Cr.0.5 Mo (SA335 P12)	150° C upto 38 mm thickness 200° C for over 38 mm and upto 63 mm thickness
1.25 Cr 0.5 Mo (SA335 P11)	150° C upto 38 mm thickness 200° C over 38 mm and upto 63 mm thickness 250° C for over 63 mm thickness
2.25 Cr 1 Mo (SA335 P22)	200° C upto 38 mm thickness 220° C over 38 mm and upto 63 mm thickness 250° C for over 63 mm thickness

1.27.1.2 At no time during the welding operation, shall the temperature of the welding area be allowed to fall below these temperatures. Before performing any tack welding which may be required in preparing alloy pipe for welding or other fabrication or before attaching thermocouple, the pipe area to which the tack weld is to be made shall be uniformly heated to the temperature indicated above preferably by resistance heating or induction coils. Propane gas or natural gas torches or preferably burner rings shall be employed where it is not possible to use electric heating. Heating by Oxy-acetylene gas is prohibited. The metal temperature in this procedure shall be determined by the use of thermocouples and potentiometers except that temperature sensitive crayons shall be used as temperature indicators in tack welding thermocouples.

1.27.1.3 Weld joints for piping NB 100 and larger shall be heated by means of induction coils or resistance heating. Welded joints in smaller pipe shall be heated by means of electrical resistance coils or suitable propane or natural gas torches.

1.27.1.4 Austenitic Stainless Steel

Welded joint in Austenitic Stainless Steel Piping need not be preheated except where the ambient temperature is below 0 ° C. For this condition, the joint shall be heated to 40 ° C by propane, natural gas or electrical means before any welding is performed.

1.27.2 Stress Relieving

Stress relief of piping material is required when so specified and shall be performed as specified ASME and / or IBR.

1.27.3 General Requirement

A complete automatic temperature recording shall be made of preheating and stress relieving operations where propane gas burners or electrical resistance coils are employed. A complete temperature record of the preheating and stress relieving operations shall be made by means of box type potentiometer.

Stress relieving may be performed locally or fully in furnace. Local stress relief shall be performed with electric induction or electric resistance coils. Suitable gas burning equipment using natural gas or propane may be employed.

At no time during stress relieving / preheating cycle shall any water or liquid cooling medium be employed.

Where members being joined are unequal in thickness the dimension of the heavier section shall govern the selection of width of the heated band and the duration of the holding period.

When local stress relief is performed, the area of the welded joint and the adjacent material extending for a distance of atleast three (3) times the width and widest part of the weld on each side of the weld shall be heated by band.

For local stress relief using electrical methods the minimum of two (2) thermocouples tack welded to the surface of the potentiometer shall be used on the pipe under atleast four (4) layers of asbestos paper.

The hot junctions of thermocouples shall be located on either side of the joints atleast 12 mm from the edge of the joint but no further away than 100 mm. When employing induction heating, atleast six (6) turns of induction cable shall be wrapped on top of the asbestos paper protecting the thermocouples with the first turn approximately of 150 mm from the centre of the weld.

The stress relieving shall be maintained for a period of time proportioned on the basis of one hour per 25 mm of wall thickness of the thickest section of the joint. The parts to be heated shall

be brought slowly to the required temperature and the heating rate shall not exceed 150 Deg. / hr for every 25 mm wall thickness of material.

For tubing joints and for socket welded joints, pads, bosses and couplings, one (1) thermocouple shall be positioned on the minimum distance of two (2) pipe wall thickness from the weld.

For welds used for attachment of base brackets, two (2) thermocouples shall be used for determination of pre-heating and stress relieving temperatures. They shall be tack welded directly to the header located 180 Deg. apart on the circumference of the header and the mid-way between adjacent legs.

Piping on both sides on any joint shall be adequately supported throughout the preheating, welding and stress relieving operations to prevent distortion.

All heating and cooling must be performed on still air.

1.27.4 Carbon Steel

Welded joints on carbon steel pipe where the nominal pipe wall thickness of the heaviest material being joined is greater than 19 mm or the carbon content of more than 0.25 % for piping system under IBR and 0.3 % percentage non-IBR, shall be stress relieved upon completion of the welding operation.

When the height of the boss above OD of the pipe is 19 mm or greater the weld shall be stress relieved.

When the wall thickness of the coupling or a pad is greater than 19 mm the weld shall be stress relieved.

When local stress relief is employed, the weld joints shall be welded to a temperature of not less than 600 Deg.C. This temperature level shall be maintained within the limits of 620 Deg.C and 650 Deg.C for a period of time proportioned on the basis of one hour per 25 mm of wall thickness but in no case less than 30 minutes. The weld area shall then be allowed to cool and undisturbed in a still air to a temperature not exceeding 300 Deg.C.

All welded joints which are locally stress relieved in pipes of 100 mm NB and larger shall be heated by means of electrical induction coils or resistance heating. Welded joints in pipes smaller than 100 mm NB shall be stress relieved by means of electrical resistance coil or suitable propane or natural gas torches only.

When full furnace stress relieving is employed for a welded assembly, the entire fabricated section shall be heated uniformly and at no time during the subsequent heating cycle, shall the temperature be allowed to exceed 650° C or fall below 600° C. The furnace shall then be adjusted so that the material will cool at a controlled rate not to exceed 150° C until 300° C is reached. However, in no case the cooling rate shall not exceed 150° C per hour. At that time,

the furnace may be shut off, the door opened and the piping material allowed to cool normally to handling temperature.

1.27.5 Heating and Cooling

The carbon steel after having reached their specific stress relief temperatures may be cooled under wraps (i.e.) leaving the induction coils or resistance heaters and insulation in place. This means that at the stress relief temperature the power to the furnace or heating coils may be shut off and cooling takes place in the furnace or with all insulation and coils remaining on the pipe. The stress relieving coils and insulation shall only be removed after the pipe has cooled below 300° C.

For furnace stress relief, the doors of the furnace may be opened after the power is shut off at 300° C. The thermocouples controlling the temperature shall remain during the cooling cycle so that the excessive cooling, if it occurs, can be observed and immediately corrected. The rate of heating and cooling shall conform to Cl. 132.5 of ASME B 31.1 and / or IBR. This stress relieving coils and insulation shall be removed only after the piping has cooled to below 300° C or if stress relieved in a furnace, the pipe may be removed from the furnace and permitted to cool in still air at a temperature of not below 10° C.

1.27.6 Alloy Steel

1.27.6.1 All welds in alloy steel piping shall be stress relieved after welding operation in accordance with the details given below:

MATERIAL	STRESS RELIEVING TEMPERATURE °C		REMARKS
	Min.	Max.	
1 Cr 0.5 Mo (SA 335 P12)	640	680	Over 13 mm minimum wall thickness or
1.25 Cr 0.5 Mo (SA 335 P11)			over 100 mm NB or over 15% C max.
2.25 Cr 1 Mo (SA 335 P22)	680	725	Over 8 mm minimum wall thickness or over 100 mm NB or over

1.27.6.2 The welds need not be stress relieved immediately after welding. Immediately after welding, the material shall be wrapped in asbestos and allowed to cool in still air. Full stress relief shall be performed commensurate with alloy after the above slow cooling. The stress relieving procedure shall include the welding joints, and the adjacent material extending for a distance of at least 3 times the width of the widest part of the weld on each side of the weld. The stress relieving temperatures shall apply for local or furnace stress relieving.

1.27.7 Heating and Cooling

The low and medium alloy steels, after welding, shall be heated to their specific stress relieving temperature at a rate not to exceed 150° C per hour. The procedure for heating shall employ a suitable furnace, induction coils or electric resistance heaters and shall be controlled by at least two thermocouples.

1.27.8 Local Stress Relief

All welded joints in pipe 100 mm NPS size and larger shall be locally stress relieved by means of electric induction coils or resistance welding. Welded joints in smaller pipe sizes shall be stress relieved by means of electric resistance coils or suitable propane or natural gas torches only.

For full furnace stress relief of a welded assembly, the entire fabricated section shall be heated uniformly to the temperature specified. The temperature shall be maintained for a period of time proportioned on the basis of one hour per 25 mm of wall thickness of the piece having the greatest wall thickness in the furnace charge, but in no case less than one hour.

1.27.9 Austenitic Stainless Steel

Joints in Austenitic stainless steel piping need not be stress relieved after welding.

1.27.10 Electrodes

The specification and size of the electrodes, voltages, amperages, thickness of beads and number of passes shall be as specified in the approved welding procedure or otherwise agreed in writing. In general, basic coated electrodes shall be used which shall be deposited with weld metal having the same or higher physical properties and similar chemical composition to the members being joined. For each batch of approved brand, certificate showing compliance with the specification shall be secured and shall be submitted to the **PURCHASER / CONSULTANT** for review before being released for use on project piping. All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. All low hydrogen electrodes shall be baked in mother oven between 300 to 350° C for one hour and stored in holding oven at 80 to 100° C before being used. The recommendation of the electrode manufacturer shall be followed.

For welding of all grades of steel and alloys by the GTAW process, a two (2) percentage thoriated tungsten electrode conforming to AWS / ASME section II part C classification shall be used.

1.27.11 Carbon Steel and Alloy Steel

All electrodes to be used in carbon steel and Alloy Steel shall conform to ASME SEC II PART C or IS 814 or any other equivalent codes.

As welding electrodes deteriorate under adverse conditions of storage leading to dampness in the electrode coating, they should be normally stored in air conditioned rooms or in hot boxes or ovens in their original sealed containers whose temperatures shall be maintained within specified limits. The condition of electrodes shall be frequently inspected. The electrodes with damage to coating shall not be used. Electrode shall remain identified until consumed.

The type of electrode used should be only those recommended by the manufacturer for the use in the position in which the welds are to be made. Electrodes which have the areas of flux covering broken away or damaged shall not be used.

All piping coming under the IBR shall have root run carried out using "TIG" process and further run by attested electrodes for various material combination and the selection of electrodes shall be as specified in Exhibits.

2 Safety Valves

The safety valves shall be semi nozzle full lift, and open bonnet type and the selection and sizing of the safety valves shall conform to the provisions of the IBR for the Boiler safety valves (drum and superheater safety valves). For other safety valves, the safety valve shall be full nozzle full lift and open bonnet type and selection and sizing shall conform to the provisions of the IBR. In addition to meeting this requirements, the safety valves shall also meet the stipulations of ASME Section I with regard to the blowdown and overpressure requirements. The inlet of the boiler safety valves shall be with butt welding end and all other safety valves shall be with flanged ends.

The body material of the superheater safety valve and electromatic safety valve shall be SA 217 Gr.WC6.

The valves shall be supplied with lifting lever, test gag, cap and spring cover.

The capacities of the safety valves provided downstream of pressure reducing stations shall be the maximum flow permissible thro' the control valves under 100 % valve opening with the rated full upstream pressure. The safety valve at the superheaters of the boiler "**shall not be located**" on the superheater headers. The superheater outlet safety valve shall be located at a distance of minimum 8 times the diameter of pipe from the superheater outlet elbow (outlet weld).

The safety valves provided on CBD tank shall be sized for relieving the entire quantity of steam when the CBD valve is opened 100%.

APPENDIX - IV

CODES & STANDARDS

1 Boiler

1.1 General codes

IS : 875 / 1987	for design loads of buildings and structures
IS 1893	for criteria for earthquake resistant design or structure
IS 800	code of practice for use of structural steel for general building construction.
IS 806	for use of steel tubes in general building construction
IS 4592	for industrial type metal floors, walkways and stairs
IS 5395	for stairs, ladders and walkways
IS 875 and IS 1893	for design loads

For live loads the minimum loading will be 300 kg/sq.m and for operating platforms will be 500 kg/sq.m.

IS 875 (part 3) 1987	for wind loading
IS 1893	for seismic load.

Minimum width of platforms and walkways will be 750 mm. Minimum head room will be 2200 mm. All stairs will have minimum clear width of 750 mm & slope will not exceed 45 °

BS 4952 part I for gratings of structural steel.

All electricals to be approved by Bidder from CEIG-M.S.. Switch board of motor control centres to be suitable for 415 volts, 3 phase, 4 wire, 50 Hz, enclosure - IP 52, fault level of 50 KV for 1 sec., design ambient temp. of 45 ° C and max. operating temp. of 85 ° C.

- 1.2 Steam services at temperature less than 427⁰C steam generator feed, condensate and drain piping, carbon steel piping as per ASTM A - 106 Grade B or equal.
- 1.3 HP & LP chemical dosing system: Stainless Steel piping.
- 1.4 Other services: Carbon steel piping as per ASTM A- 106 Grade B or ASTM A- 53.
- 1.5 Fittings and Flanges: As per applicable codes conforming to pipe material specifications.
- 1.6 For cooling water and raw water applications the piping material shall be IS 1239 Black Medium Class.

1.7 For Service air applications to piping shall be IS 1239 Black Medium Class.

1.8 For instrument air applications: IS 1239 GI pipes

1.9 The fittings for ERW applications shall be as per IS 1239 Part II.

1.9.1 Instrument Connection

- The connection of Instruments installed on steam generator, pipes tanks and piping shall be approved by Owner/ Consultants.
- Pneumatic connection for signal and air supply shall be 1/4 " NPTF.
- Electrical connection shall be 1/2" NPTF.
- Threaded and connection shall be to NPT as per ANSI B2.1 and flanged end connections shall be as per ANSI B 16.5.

1.9.2 Temperature Instruments

- a. All temperature elements shall be provided with thermo-wells fabricated out of bar stock of minimum SS 304 materials. Immersion length of thermo-wells shall be as follows:

Line size	Immersion length
From 4" to 6"	290mm
From 8" onwards	320 mm
Vessels	400 mm

Any pipe line less than 4" nominal bore shall be blown to 4" size to install thermo wells.

- b. Local temperature gauges shall be generally mercury in steel filled type, weather proof, hermetically sealed with 1150 mm dial size. Filled type with capillary extension shall be used for local gauges, where vibration is a problem. Capillary tubing shall be minimum of SS 304 with stainless steel flexible armouring . The gauges shall have accuracy of $\pm 1\%$ FSD.
- c. For remote temperature indication/ recording control etc. Duplex type thermocouples or RTD shall be used depending on the requirement. Ambient temperature compensation shall be provided for the thermocouples.

Thermocouples shall be as per ANSI MC 96.1 and shall be of 14 AWG magnesium oxide insulated grounded type. These shall be selected as follows :

- a) Copper - constantan (ISA -TYPE T) for ranges:200 to 200⁰C.
- b) Chromel - Constantan (ISA- TYPE E) for ranges:200 to 600⁰C.
- c) Chromel - Alumel (ISA- TYPE K) for ranges:600 to 1200⁰C.

RTD shall be platinum element with 100 ohms resistance at 0⁰C calibrated as per DIN43760. RTD shall be 3 wire type.

Twin element sensors, if used, shall have 2 separate conduct entries.

- d. Panel mounted electronic temperature indicators/ scanners shall be digital type and recorders shall be potentiometric null-balance type. Burn out or RTD protection shall be considered for local temperature control.

1.9.3 Pressure Instruments

Pressure gauges shall have an accuracy of $\pm 1\%$ of FSD. These shall be weatherproof with dial size of 1150 mm and shall have features like screwed bezels, externally adjustable zero, over range protection and blow-out discs. Pressure gauge sensing element shall be minimum of SS 316 and movement of SS 304.

Pressure transmitters with local indicator shall be electronic capacitance type with minimum of SS 316 element material with a over range protection of minimum 130 % of range.

Direct mounted pressure switch shall have elements either diaphragm or bellow of minimum of SS 316 material with 1/2" NPTF connection .

1.9.4 Level Instruments

Steam generator drum gauge glasses shall be steel armoured reflex or transparent type with body materials of carbon steel as a minimum and tempered imported borosilicate glass.

Differential pressure transmitter shall be used for level measurement.

Level switches shall generally be external ball float type with flanged head.

1.9.5 Flow Instruments

Flow measurement shall normally be done with thin plate square edge concentric orifice plate mounted between a pair of weld neck flanges of minimum 300 pounds ANSI rating with flange. The material of the orifice plates shall be normally SS 316.

Metering orifice shall not be installed in lines less than 40 mm nominal diameter meter runs shall be for a maximum d/D ratio of 0.75. For larger size pipes actual d/D ratio shall govern the straight run.

DP type flow transmitter shall normally be electronic balance / capacitance / strain gauge type with receiver gauge or inductor for output indication .

1.9.6 Control Valves

Control valves shall normally be globe type. Other types like butterfly ball valves, angle valves, 3 way valves, etc. shall selected as per service .

Minimum body and flange rating of control valves shall be as per piping class .

Body material as a minimum, shall be as per piping specifications .

Minimum control valve body size shall be 1". Reduced trims can also be considered . Body size shall be limited to the following .

1", 1 1/2" , 2" , 3" , 4" , 5" , 8" , 10" and 12".

Material used for trim shall be minimum 316 SS. For higher pressure drops, flashing, erosive and slurry services and, in general, all steam services, trim shall be stellited.

Valve seat leakage shall be as per ANSI B 16.104 .

Valves positioners wherever used shall be side mounted forced balance pneumatic type. For electronic instrumentation, I/P converter shall be used along pneumatic positioners and air filter regulators.

Self actuating regulators for flow, pressure and temperature shall be used loads are constants and requirement of precision controls.

1.9.7 Junction Boxes

Junction boxes shall be provided wherever required. These shall be of die cast aluminium alloy body and shall be weather proof.

These boxes shall have terminals suitable for min 2.5 Sq.mm cable termination (clip on) mounted on rails. 20% spare terminals shall be supplied in each junction box.

Junction box wherever required shall be supplied .Each junction box shall have a minimum of 20% or 10 Nos. whichever is more, spare entry duly provided with plugs .

1.9.8 Instruments Valves and Manifolds

Bidder shall supply instrument valves (miniature type) and valve manifolds wherever required .

Body material and rating shall be as per piping class as SS whichever is better and shall be forged type .

Valve trim material shall be 316 SST as minimum or superior as required by process conditions.

Bidder shall supply a minimum of 10% of such instrument valve and manifolds as spare .

1.9.9 Impulse Piping / Tubing

In general , bidder shall supply 1/2" x 0.065" thick ASTM A 269 TP 316 stainless steel as minimum seamless tubes for impulses kines

Where the pressure (operating) exceeds 70 kg /Sq. Cm (g) seamless pipes of size 1/2” NB of required thickness shall be supplied with material as per piping class .

Seam less tubes shall have a hardness of max. 90 RC as typical.

Bidder shall supply a minimum of 20% of pipes / tubes as spare .

1.9.10 Pipes and Tube Fittings

The ferrule hardness shall be greater than 90 RC and of stainless steel in general . Socket-weld type forged pipe fittings of suitable material and ratings shall be supplied for pipe fittings. The minimum rating shall be 3000 lbs . Bidder shall supply a minimum of 20% of each type of pipe / tube fittings as spare .

1.9.11 Pneumatic Signal Tubes

Bidder shall supply 6 1/4” OD x 1 mm thick PVC converted fully annealed electrolytic grade copper tubes as per ASTM B 62.74 A CU.NO 122 (DH) for pneumatic signal tubes .

Bidder shall avoid use of intermediate connections and shall estimate single length for each instrument location .

Bidder shall supply a minimum of 20% of these tubes as spare.

1.9.12 Instruments Support / Structural Steel

Bidder shall supply instrument stands (stanchions and other structural steel material required for supporting the cable trays . In boxes, stands for mounting instruments, canopies for field electronic / pneumatic instruments.

2 Standards for Electrical design

IS 3427	Metal enclosed switchgear and control gear (1 KV to 11KV)
IS 375	Marking and arrangement of switchgear bus bars
IS 2705	Specifications for current transformers
IS 3156	Specifications for voltage transformers
IS 3231	Electrical relays for power system protection
IS 1248	Electrical indicating instruments
IS 722	Integrating meters
IS 6865	Control switches and pushbuttons
IS 694	PVC insulated cable with copper for voltages Up to 1100kv control
IS 325	Three phase induction motors
IS 638	Sheet rubber jointing and rubber insertion jointing
IS 694	PVC insulated cables for working voltages up to and including 1100 volts
IS 722	AC electricity meters
IS 732	Code of practice for Electrical wiring installations

- IS 1239 Part I : Mild steel tubing
 Part II : Mild steel tubular and other wrought steel pipe fittings

- IS 1248 Direct acting indicating analogue electrical measuring instruments and their accessories

- IS 1293 Plugs and socket outlets of 250 volts and rated current up to 16 amps
- IS 1364 Hexagon head bolts, screws and nuts of product grades A & B
- IS 1367 Technical supply conditions for threaded steel fastener
- IS 1554 PVC insulated (Heavy duty) electric cables
- IS 1913 General and safety requirement
- IS 2223 Dimensions of 3 phase flange mounted motors
- IS 2253 Types of construction and mounting of motors
- IS 2834 Shunt capacitors for power system
- IS 2419 Dimension for Panel Mounted indicating and recording electrical instruments

- IS 2551 Danger Notice Plates
- IS 21107 Fittings for rigid steel conduits for electrical wiring
- IS 2705 Current Transformer
- IS 3043 Code of Practice for earthing
- IS 3156 Voltage transformers
- IS 3231 Electrical relays for power system protection
- IS 3646 Code of practice for interior illumination.
- IS 3725 Resistance wires, tapes and strips for heating elements
- IS 3961 Recommended current ratings for cables
- IS 5216 Recommendations on safety procedures and practices in electrical work
- IS 5578 Guide for marking of insulated conductors
- IS 6875 Control switches (switching devices for control and auxiliary circuits, including contactor relays) for voltages up to and including 1000 V AC and 1200 V DC

- IS 7098 Specification for cross linked polyethylene insulated PVC sheathed cables
- IS 8828 Miniature circuit breakers
- IS 13703 Low voltage fuses

- IS 9385 High voltage fuses
- IS 10118 Code of practice for selection, installation and maintenance of switchgear and control gear
- IS 1271 Classification of insulating material
- IS 12360 Voltage bands for electrical installations including preferred voltage and frequency
- IS13947 Motor starters for voltage not exceeding 1000 Volts
- IS13032 MCB Distribution Boards
- IS13947 Degrees of protections provided by enclosures for low voltage switchgear and control gear
- IS13947 Moulded case circuit breakers
- IS 3427 Metal enclosed switchgear and control gear (1 KV to 11KV)
- IS 375 Marking and arrangement of busbars in switchgear panels
- IS 2705 Specifications for current transformers
- IS 3156 Specifications for voltage transformers
- IS 3231 Electrical relays for power system protection
- IS 1248 Electrical indicating instruments
- IS 722 Integrating meters
- IS 6865 Control switches and pushbuttons
- IS 694 PVC insulated cable with copper for voltages up to 1100V

3 Standards for refractory & insulation

- | | |
|---------------|---|
| IS 5970 | for thermal insulation |
| IS 737 | for aluminium cladding |
| IS 8183 | for bonded mineral wool |
| IS 3150 | for hexagonal wire net |
| IS 3144 | for testing of mineral wool |
| IS 3346 | for determination of thermal conductivity |
| IS 8 and IS 6 | for refractory bricks |

4 Standards for cables

The cables shall comply with the latest edition of the following standards:

- IS : 1554 (Part-1) - PVC insulated (heavy duty) electric cables - Part-I for working voltage Up to and including 1100 V.
- IS : 8130 - Conductors for insulated electric cables and flexible cords.
- IS : 5831 - PVC insulation and sheath of electric cables.

IS : 3961 (Parts-II)-Recommended current ratings for cables : Part-II PVC insulated and PVC sheathed heavy duty cables.

IS : 1753 -Aluminium conductors for insulated cables.

APPENDIX - V

PAINTING SUMMARY

1 General

- 1.1 This specification covers the materials, tools, facilities and quality requirements for surface preparation and painting of steelwork, equipment, including pipework, ductwork etc. The requirements brought out herein are applicable both for shop painting and painting at the site.
- 1.2 Surface directly embedded in concrete, asbestos, aluminium, brass, bronze, galvanised steel, stainless steel and other corrosion resistant alloys, rubber / synthetic polymers, and buried pipework are not required to be painted unless specified, except for identification bands, where relevant. Except for such surfaces, painting and surface preparation shall be provided to protect all surfaces that shall be subject to atmospheric action and exposed to corrosive media, irrespective of mention in the other General and Technical Specification.
- 1.3 Painting shall provide a continuous adherent film of adequate thickness on the surface being treated and atmosphere prevailing at the site and exposures in other corrosive environment. The climatic conditions of site is outlined in the contract documents. The work shall consist of surface preparation and application of prime, intermediate and finish coats of organic and inorganic coating or metallic coating as specified herein.

2 Standards

- 2.1 All materials, tools and workmanship shall be in accordance with the latest editions of relevant Bureau of Indian Standards wherever available. Where Indian Standards are not available, the work shall conform to generally accepted codes of practice for good painting, based on specifications such as those published by Steel Structures Painting Council, USA, or as per DIN 55928.

3 Surface Preparation

- 3.1 Surface preparation being a pre-requisite for any paint application, shall be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint sub-strata.
- 3.2 All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding flux etc. irrespective of whether the same has been spelt out in the standards in order that the primer coat is rigidly anchored to the virgin metal surface. The surface cleaning shall conform to pictorial representation of surface quality grade of Swedish Standards Institution SIS 055900 or equivalent standards such as SSPC-VISii-1.67 or DIN 55928 (Part IV) or BS:4232 or IS:1477 standards of surface preparation quality grade to be adopted in respect of SIS 055900. Any oil, grease, dust or foreign matter deposited on the oil surface after preparation shall be removed and care taken that the surface is not contaminated with acids, alkalis, moisture or other corrosive chemicals. The primer coat shall be applied as soon as possible after the surface preparation is completed.
- 3.3 The acceptable surface preparation standards are described under each paint system. The procedures covered are solvent cleaning, hand tool cleaning, power tool cleaning, flame cleaning, blast cleaning, pickling or combination thereof. These are briefly described below.

APPENDIX - V (contd..)

3.4 The surface preparation quality such as St-2, St-3, Sa-2, Sa-2 1/2 etc. shall be compatible with the selection of primer paint and overall life of the paint system adopted.

3.5 Solvent Cleaning

The surface is cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with emulsion or alkaline solution or chemical paint stripper. The method effectively removes oil, grease, dirt, matters but does not remove rust, scales, mill-scales or weld flux. Also, hydrocarbon solvents do not remove corrosive salts such as chloride and sulphate. Therefore, before application of paint, solvent cleaning is commonly to be followed by other cleaning procedures.

3.6 Hand Tool Cleaning

The surface is cleaned by vigorous wire brushing done manually to St-2 quality. Chipping and scraping is usually carried out before wire brushing; oil and grease are removed by solvent cleaning before hand tool cleaning. On welded work, before wire brushing, particular care should be taken to remove by blasted cleaning, washing with water, phosphate rinsing of power tool cleaning as much welding flux, slag and fume deposit as is possible. This method effectively removed loosely adherent materials but would be not affect residues of rust or mill scales that are intact and firmly adherent.

3.7 Power Tool Cleaning

The surface is cleaned by electric or pneumatic tolls, such as brushes, sanding machines, sanding discs, abrasive grinders, chipping, hammers, scalers, needle guns and rotary descalers to St-3 quality. Oil and grease are first removed by solvent cleaning and heavy rust scale removed prior to use of power tools. The tools are used carefully to prevent excessive roughening of surface and formation of ridges and burrs; also, care is taken to avoid mill scale being burnished to a smooth, slick surface. This method will remove loosely adherent material but would not affect residues of rust, or mill-scales that are intact and firmly adherent.

4 Paint Materials

4.1 The paint systems specified herein and for different exposure conditions shall be the minimum acceptable quality of surface protection against the respective environment, provided the paint materials are manufactured from quality products under stringent quality control. For any proprietary paint formulation, the performance of which has been tested in actual site conditions or under stimulated conditions in test laboratory, the manufacturer's recommendations in all respects shall be adhered to.

4.2 The vehicle for the specified paint products of a particular system for the respective service exposure conditions shall be one of or a combination of the following to provide a compatible paint system as a whole:

- i. Synthetic enamel of oil-alkyd based or acrylic modified alkyds or styrenated alkyd.
- ii Modified phenolic alkyd.

APPENDIX - V (contd..)

- iii. Chlorinated rubber.
 - iv. Two component epoxy-polyamide free of alkyds and plasticizer.
 - v. Two component epoxy-polyamide for stove drying.
 - vi. Two component polyurethane
 - vii. Silicone
 - viii. Bituminous
 - ix. Coaltarepoxy
- 4.3 The rust inhibitive pigments shall be any one of or a combination of the following depending on the nature of exposure and compatibility with other ingredients present in the selected vehicle:
- i. Red lead (about 96% Pb 304, 4% PbO)
 - ii. Zinc Chromate (about 38% ZnO, 44% CrO₃)
 - iii. Zinc Phosphate
 - iv. Manganese Phosphate with Barium Chromate
 - v. Zinc Dust (about 96% Zn)
 - vi. Non-leafing aluminium

Red lead pigment shall not be used in case of paint being sprayed.

5 Mixing and Thinning of Plant

- 5.1 All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse homogeneity. Mixing shall be mechanical except when the container size is 20 litres or less; mixing by air bubbling is not permitted. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.
- 5.2 Dry pigments, pastes, tinting and colours shall be mixed and / or made into paint so that all dry powders get wetted by vehicles and lumps and particles are uniformly dispersed.
- 5.3 Additives that are received separately, such as curing agents, catalysts, hardeners etc. shall be added to the paint as per manufacturer's instructions. These shall be promptly used within the pot life specified by the manufacturers and unused paint thereafter discarded.

5.4 Thinners shall not be used unless essential for proper application of the paint. Where thinners are used, they shall be added during the mixing process and the type and quantity of thinner shall be in accordance with the instructions of the paint manufacturer.

5.5 Storage of Paint

5.6 All paints shall be stored strictly in accordance with requirements laid down by the paint manufacturer. The storage area shall be well ventilated and protected from sparks, flame, direct exposure to sun or excessive heat, preferably located in an isolated room or in a separate building.

5.7 All paint containers shall be clearly labeled to show at the time of use the paint identification, instructions in legible form. The containers shall be opened only at the time of use. Paints which have livered, gelled or otherwise deteriorated during storage shall not be used. Paints for which the shelf life specified by the manufacturer has expired, shall not be used without inspection and approval by the Purchaser.

6 Paint Application

6.1 General

Paint shall be applied in accordance with manufacturer's recommendations as supplemented by this specification and the work shall generally follow IS:1477 (Part II).

Paint shall generally be applied by brushing except that spraying may be used for finish coats only when brushing may damage the prime costs. Roller coat or any other method of paint application shall not be used unless specifically authorized. Spraying shall not be adopted on red lead or zinc rich paints.

Paint shall generally not be applied when the ambient temperature is 5°C and below; for paint, which dry by chemical reaction, the temperature requirements specified by the manufacturer shall be met with. Also, paint shall not be applied in rain, wind, fog or at relative humidity of 80 percent and above or when the surface temperature is below dew point resulting in condensation of moisture. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint.

Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots. The film thickness shall not be so great as to affect detrimentally either the appearance or the service of the paint.

Each coat of paint shall be allowed to dry sufficiently before application of the next coat to avoid damage such as lifting or loss of adhesion. Undercoats having glossy surface shall be roughened by mild sand papering to improve adhesion of subsequent coat. Successive coats of same colour shall be tinted, whenever practical, to produce contrast and help identify the progress of work.

6.2 The application of paint by brush or spray are covered below:

Brush Application

Signature and Seal of the Bidder

HBL/TEN/PUB/20-21/223 dated 06.02.2021

Page 265 | 278

(COMMERCIAL & TECHNICAL UNPRICE BID)

Proper brushes shall be selected for a specific workpiece. Round or oval brushes to IS:487 are better suited for irregular surfaces whereas flat brushes to IS:384 are convenient for large flat areas. The width of flat brushes shall not generally exceed 125 mm.

Paint shall be applied in short strokes depositing uniform amount of paint in each stroke followed by brushing the paint into all surface irregularities, orifices and corners and finally smoothing or leveling the paint film with long and light strokes at about right angles to the first short strokes. All runs and sags shall be brushed out. The brush marks shall not be left in the applied paint as far as practicable.

6.3 Spray Application

The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned of dirt, dried paint, foreign matter and solvent before use.

The paint shall be applied by holding the gun perpendicular to the surface, at a suitable distance and moved in a pattern so as to ensure deposition of an uniform wet layer of paint. All runs and sags shall be brushed out immediately; areas not accessible to spray shall be painted by brush or dauber.

6.4 Shop Painting

All fabricated steel structures shall have a minimum of two primer coats before despatch to site. The paint shall be applied immediately after surface preparation to the specified quality, preferably within two hours.

Surface in contact during shop assembly shall not be painted. Surfaces in contact after field erection shall receive three shop coats of specified primer unless the paint will interfere with assembly. Surface which will be inaccessible after assembly shall also receive three shop coats of specified primer. Surfaces which cannot be painted but required protection shall be given a coat of rust inhibitive grease to IS:958 or solvent deposited compound to IS:1153 or 1674 or an International equivalent.

Surfaces to be in contact with concrete shall not be painted. Surfaces to be in contact with wood, brick or other masonry shall be given one shop coat of the specified primer.

The shop coats shall be continuous overall edges including ends meant for joining at site by welding, except where the paint is harmful to welding operator or is detrimental to the finished welds. In such cases, the prepared welding edges and the joint zone are coated with epoxy based weldable blast primer over a width of approximately 50 mm. Then the welding edge and the joint zone are covered with an adhesive tape over a width of approximately 50 mm and the work piece is coated with full coats of shop painting. Then the adhesive tape is removed. The welding edges and the joint zones are not coated with primer / rust inhibitive compounds and intermediate coats since the complete removal of these layers in the site cannot be guaranteed, but is absolutely vital for the quality of the welds.

Small machinery, motors, electrical equipment and instruments etc. shall receive the full specified coats of paint in the shop.

Large machinery, large motors, cranes, gear cases, conveyors etc. shall be shop painted completely as per the relevant paint system taking into account the exposure conditions.

6.5 Site / Field Painting

After the erection / assembly of fabricated structures at the plant site, damaged and defective shop coats shall be touched up with the same type of paint as used for shop coat. The work shall include removal of damaged paint work, surface preparation of the damaged area (due to damage of shop coat or due to site fabrication) to St-3 quality and painting thereof to cover-up all field connections, welds, rivets and all damaged or defective paint and rusted areas. The fabricated steel structures shall then be painted with finish coats as specified.

6.6 If necessary, equipment and large machinery shall be give one finish coat compatible with shop coats after necessary cleaning and touch up.

6.7 The first coat of paint at site shall be applied before weathering of the shop coat becomes excessive, preferably within three months of the shop coat. The finish coat of paint shall be applied after all concrete work has been complete and all cement and concrete spatters and drippings removed and damaged surfaces touched up before application of the finish coat.

6.8 If in the opinion of the Purchaser, the damage to shop cost is extensive, then instead of spot touch up one overall coat of primer for each shop coat shall be applied after cleaning. Surfaces which have not been shop coated but require to be painted shall be given the necessary surface preparation and prime coat before application of intermediate and finish coats and before any damage occurs to the surface from weather or other exposure.

6.9 Steel structures which are fabricated at site shall be painted with prime and finish coats after necessary surface preparation as specified after fabrication and erection at site.

6.10 All cracks and crevices shall be filled with compatible paint or putty.

6.11 All field welds and all areas within 50 mm of welds shall be cleaned before painting, using surface preparation method as specified to attain the specified surface quality grade; in any event all welds shall either be blast cleaned, or thoroughly power wire brushed or chemically scrubbed or solvent cleaned depending on the nature of the weld deposits.

6.12 During application of paint at site care shall be taken to protect any damage to building, floors, structures, electrical equipment including motors, valve stems, glass, moving parts, bearings, couplings, shafts, lubrication points and other sensitive parts. Any paint falling on or applied to such surfaces shall be removed.

7 Colour Code

7.1 Shades of finish paint coat to be applied shall be as per IS:5 or as per Munsell colour reference (published by Munsell Colour Co Inc, Baltimore, USA). However, prior approval shall be taken from the **PURCHASER** after placement of order before adopting final colour shade for any particular item being painted.

APPENDIX - V (contd..)

8 Inspection and Testing

- 8.1 The **CONTRACTOR** shall ensure that the surface treatment and painting carried out meets the requirements of the relevant painting systems specified. The **CONTRACTOR** shall furnish to the **PURCHASER** test certificates, inspection and test report to conform compliance to the standards specified.
- 8.2 Paint manufacturer's test certificates to show the quality of materials used in the paint shall be furnished.
- 8.3 The inspection and test reports shall include but not limited to the following essential information; grade of surface preparation, paint system adopted, name of paint manufacturer, dry film thickness of each coat as measured.

Shades of finish coat of paint applied over respective items as under :

Items painted	Colour
Structures:	
Building frames including bracings, side girts, louvres etc.	Aircraft grey
Crane girders	India saffron
Crane stops	Post office red
Gutters	Black bituminous aluminium
Fire escape platforms ladders etc	Signal red
General hand railing, top runners	Lemon yellow
Rung ladders	Lemon yellow
All members blocking passages for movement	Lemon yellow
Trestles, towers and pipe bridges	Dark admiralty grey
Conveyor gallery structures	Aircraft grey
Mechanical and Electrical equipment:	
General indoor equipment	Opaline green
General outdoor equipment	Dark admiralty grey
Crane bridges, trolleys, hooks etc and other mobile equipment	Base : Lemon yellow Stripes : Black (300 mm wide)
Furnaces	Aluminium
Tanks	Base : Same as for general equipment Stripes : Same shade as for piping around the tank as half the tank height
Fire fighting equipment	Signal red

APPENDIX - V (contd..)

9 Pipework :

Colours shall be as given below. The base colour shall be applied throughout entire length except, on surfaces of materials such as asbestos, aluminium, brass, bronze, galvanised steel, stainless steel and other corrosion resistant alloys and rubber / synthetic polymers.

In such cases identification colour bands of at least 500 mm width shall be provided near each branch, valve and at distances not exceeding 10 m either as local colour coatings or coloured adhesive tape of suitable material or label attached to the pipework. Additional identification bands superimposed over the base colour shall be provided near each branch, valve and at a distance not exceeding 10 m, the bands shall be at least 25 mm wide except in case of double bands where the first band shall be about 100 mm wide. Direction of flow shall be clearly marked on the pipelines at intervals not exceeding 10 m and at all branches and change of direction;

Items painted	Colour		
River water (untreated)	base	-	Sea green
	Band	-	White
Cooling water	base	-	Sea green
	Band	-	French blue
Boiler feed water	Base	-	Sea green
Condensate	base	-	Sea green
	Band	-	Light brown
Drinking water	base	-	Sea green
	first band	-	French blue
	Second band	-	Signal red
Industrial water	base	-	Sea green
	Band	-	Light orange
Compressed air	Base	-	Sky blue
Instrument air	base	-	Sky blue
	Band	-	Light brown
Steam			
a. Very high pressure steam	base	-	Aluminium
	band	-	Silver Green
b. High pressure steam	base	-	Aluminium
	Band	-	French Blue

APPENDIX - V (contd..)

Items painted	Colour		
c. Medium Pressure Steam	base	-	Aluminium
	Band	-	Gulf Red
d. Low pressure steam (SL)	base	-	Aluminium
	Band	-	Canary Yellow
Transformer oil	base	-	Light brown
	Band	-	Light orange
Fuel oil	base	-	Light brown
	Band	-	Signal Reds
L.P. gas	base	-	Canary yellow
	First band	-	Signal red
	Second band	-	Traffic green
Nitrogen	base	-	Canary yellow
	Band	-	Black
Ammonia	Base	-	Dark violet
Carbon-di-oxide	base	-	Canary yellow
	Band	-	Light grey
Hydroflouric (1) acid (conc.)	base	-	Dark violet
	Band	-	Silver grey
Fire-fighting system	Base	-	Signal red
Rain water down pipes	base	-	Sea green
	Band	-	Sky blue
Duct work	Base	-	Aluminium
Lighting conduits	base	-	Black
	Band	-	Yellow
Instruments - conduits	base	-	Black
	Band	-	Red
Power – conduits	Base	-	Black

APPENDIX - VI

MOTOR SELECTION PARAMETERS

A. SUPPLY

VOLTAGE	:	415 +/- 10% V
FREQUENCY	:	50 +/- 5% Hz
FAULT LEVEL	:	50 KA for 1 second
COMB. VARIATION	:	+/- 10%
PHASES	:	3
WIRES	:	4

B. SITE

AMBIENT FOR DESIGN	:	50 ⁰ C
ALTITUDE	:	400 Meters
AREA CLASSIFICATION	:	Dusty

C. MOTOR

TYPE	:	3 Phase squirrel cage induction motors to IS 325 & IE 2
ENCLOSURE	:	TEFC for all motors
PROTECTION	:	IP – 55
METHOD OF STARTING	:	ID, FD, SA / PA fan, BFW pumps motors shall have AC variable frequency drives & star delta bypass. Fuel feeder motors shall have AC variable frequency drives. All other motors <30 KW shall have DOL starting, 30 KW & above shall have star delta starting. MPCB to be

provided for motors up 22KW & MCCB for rating of 30KW and above

APPENDIX- VI (contd..)

NO. OF STARTS	:	One hot successive / Two Cold successive / Three equally spread per hour.
MIN. VOLTAGE PERMISSIBLE FOR STARTING	:	85% rated voltage
CLASS OF INSULATION	:	F Temp rise limited to B
ACCESSORIES	:	RTD's / BTD's to be provided for all motors above 90 kW and thermistors for between 37 to 75 kW
SP. HEATER	:	Required for 30 KW & above motors (supply 240 V 1 PH)
TERMINAL BOX	:	Separate TB to be provided for SP Heater, thermistor & for power. Power TB shall be suitable for rotating in steps of 90 degrees.
CABLE ENTRY	:	Bottom /Side
DIRECTION OF ROTATION:		Bi-directional
PERFORMANCE / CONSTRUCTION	:	As per IS-325 & other related IS Standards
CABLE GLAND	:	Double compression type, brass with nickle / cadmium plating
LUGS	:	Crimping type, tinned copper
MOTOR EFFICIENCY	:	As per IE 2 min.

APPENDIX - VII

SPECIFICATION FOR INSULATION AND REFRACTORY

1.1 Scope

- a. Plastic chrome refractory to be used. For HP piping preformed insulation to be used.
- b. Finishing materials of all types including cement, protective coating, sheeting, as specified / required.
- c. Angles, irons, clamps, lugs, etc. for supporting insulation on pipes, ducts, furnace, valves & fittings and equipment.
- d. Wire mesh, lacing/binding wires, bands, straps, screws, etc. as required.
- e. Weather hoods.
- f. Refractory, insulating and red brick works with suitable bonding material.
- g. Any other material as may be required for making the refractory and insulation work complete.

1.2 Codes and Standards

The supply and application of thermal insulation to piping systems and equipment covered under this Specification shall comply with all currently applicable regulations and safety codes in the locality where the thermal insulation will be applied. The insulating materials shall also conform to the latest editions of the codes and standards listed below.

Nothing in this specification shall be construed to relieve the **SUPPLIER** of this responsibility.

IS:6 : Moderate heat duty fire clay refractories Group-A

IS:8 : High heat duty fire clay refractories

IS:737 : "Specification for wrought aluminium and aluminium alloys sheet and strip (For General Engineering Purpose)

IS:2042 : Insulating bricks

IS:3346 : Method of determination of thermal conductivity of thermal insulation material.

IS:10556 : Code of practice for storage and handling of

insulating materials.

IS:14164 : Industrial application and finishing of thermal insulating materials at temperatures above 80°C and upto 700 Deg.C

American Society for Testing and Materials

IS:8183 : "Specification for Bonded Mineral Wool"

IS 3150 : "Hexagonal wire netting for general purpose".

IS 3144 : "Methods of test for Mineral Wool Thermal Insulation Material"

1.3 General Design Requirements

All exposed portions of the plant which operate at temperatures of 60°C and above during normal operation shall be thermally insulated so that the temperature on the outer surface of the cladding shall not exceed by more than 20°C above ambient, based on an ambient temperature indicated in site data.

The specified insulation thicknesses shall not include the thicknesses of wire netting, finishing cement or any other finishing or weatherproofing application.

In refractory walls suitable expansion gaps shall be provided at regular intervals.

Removable insulation arrangement shall be provided for manholes and hand holes.

Perfect leak tight arrangement of sealing shall be provided for points at furnace roof/ wall where superheater tubes penetrate.

Insulation shall not fill the contours of the expansion bellows.

Personnel Protection

Piping and equipment that are not insulated but having a surface temperature exceeding 50 Deg.C shall be insulated for personnel protection.

1.4 Insulation of Equipment and Piping

1.4 Material Specifications

1.4.1 Insulating Materials

Compressed Resin bonded mineral wool mattress insulating material is specified in Table 1, it shall be of the required grade. The application density of insulation for temperature upto and including 400 Deg.C shall be 100 Kg/Cu.m. The application density for temperatures above 400 Deg.C shall be 120 Kg/Cu.m.

1.4.1 Sheeting Material

The sheeting material for all insulated piping and equipment shall be aluminium conforming to codes specified in Table 1. All sheeting to be riveted. The thickness of aluminium sheeting to be used shall be as follows:

- a. Pipes of 450 mm (18 in.) and above, over outside diameter of insulation - 1.219 mm (18 SWG)
- b. Pipes of 150 mm (6 in.) and above, over outside diameter of insulation but less than 450 mm (18 in) - 0.914 mm (20 SWG)
- c. Pipes less than 150 mm (6 in) over outside diameter of insulation - 0.711 mm (22 SWG)
- d. Flues and ducts, not less than 22 SWG

1.4 Piping

1.4.2 All vertical pipes shall be provided with suitable insulation supports to prevent the insulation from collapsing due to its own weight. Any welding required shall be done by the **SUPPLIER** with the prior permission of the **PURCHASER**/Engineer and only under his direct supervision. Where welding is not permitted, suitable clamped supports shall be used by the **SUPPLIER**. The insulation shall be applied starting from bottom to top.

1.4.2 The insulation shall be formed to fit the pipe and applied with edges pulled together tightly at the longitudinal joint and secured by lacing wire. The insulation shall be turned to bring this joint to the lower side.

Adjacent length shall be butted closely and laced together with lacing wire. For insulation thickness of more than 75 mm, where application will be in two or more layers, each layer of mattress shall be backed up with wire netting chosen from 20 SWG galvanised steel wire and having hexagonal opening of 25 mm size. If the interface temperature is 400 Deg.C or more, the wire netting shall be from 20 SWG stainless steel wire and having hexagonal opening of 25 mm size.

1.4.2 The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the insulation.

1.4.2 All insulation shall be protected by an outer covering of aluminium steel sheeting. All insulation sheeting joints shall be sealed and made effectively weather and water-proof. Extreme care shall be taken during the designing and installation of the insulation and the outer sheeting keeping in mind that the boiler will be installed outdoors. All flat surfaces shall be adequately sloped to prevent pools of water collecting. The sheeting shall be protected internally with 2 coats of bitumastic paint. The jackets shall be installed with the longitudinal lap joints at 45 Deg.C below the horizontal for horizontal pipes and the joints sealed with bitumastic paint.

On vertical pipes the jacketing shall be applied working from bottom up. Each section of jacketing shall have a minimum lap of 50 mm longitudinally and circumferentially. Each circumferential joint shall be made weather-proof by securing with an aluminium/galvanised steel strap and sealing with

bitumastic paint. Longitudinal lap joints shall be fixed with zinc plated screws on approximately 150 mm centres.

1.4 Valves and Fittings

- 1.4.3 All valves, fittings and specialities shall be covered with the same type and thickness of insulation as specified for the adjoining pipe, with the special provisions and/or exceptions as listed below.
- 1.4.3 All valves and flanges shall be completely insulated with removable type of boxes fabricated from aluminium sheets of same thicknesses as used on adjoining pipes. Pipe insulation adjoining flanges shall be beveled back to permit removal of the bolts and nuts. The insulation shall be applied after the finish has been applied over insulation on the adjacent piping.
- 1.4.3 Flanges on lines covered with the minimum thickness of insulation (lower temperature range) shall not be insulated. Flanges on all other lines shall be covered with provisions for making the insulation removable and replaceable.
- 1.4.3 Unions shall not be insulated.
- 1.4.3 Non Metallic Expansion Joints shall not be insulated.
- 1.4.3 Safety valves, traps and safety valve discharge lines shall not be insulated. However, trap discharge lines shall be insulated for personnel protection.
- 1.4.3 Nozzles and other connections on tanks, heaters and other equipment shall be insulated in the same manner as the pipes.
- 1.4.3 Valves shall be insulated upto and including their bonnet flange.
- 1.4.3 Pipe hanger clamps shall be covered with insulation along with the pipe. When pipe hangers pass through insulation on piping outdoor, a metal hook placed with waterproof sealing material shall be supplied and installed. Care shall be taken to ensure that the upper bolts of hangers clamps are not insulated.

1.4 Equipment

- 1.4.4 Mineral wool blanket insulation to the specified thickness shall be provided. The supplier shall tack weld suitable 9 SWG wire lugs atleast 25 mm longer than the required length to support the insulation in place. These lugs shall be bent and secured with the metal fabric of the blanket, after the insulation has been applied. Where welding is not permitted, clamps of mild steel flats with bolts, nuts and lugs welded over the flat shall be used. The lugs shall be spaced at approximately 300 mm centres. Spacer rings, at 1000 mm shall be provided for fixing aluminium sheets. All blanket joints shall be butted tightly and the blankets shall be secured with 10 mm wide 25 SWG galvanised bands. After banding, all blanket edges shall be laced tightly.
- 1.4.4 All equipment shall have a smooth sheet aluminium jacket, applied in a manner similar to that specified for piping. All vertical and horizontal sheets shall be overlapped at a minimum of 50 mm. The longitudinal lapped joints of adjoining sections of sheets shall be secured with zinc plated screws. On all vessels over 2.5 metre diameter, the jacketing shall be further secured by circumferential bands at approximately one more centres. Each sheet joint shall be sealed with bitumastic paint.

The roof sections shall overlap the side walls to prevent water seepage between insulation and the vessel wall. Side wall sheets shall be securely banded at inter-sections of the side wall and roof sections.

- .4.4.2.1** All equipment and vessel manholes, hatches, bolted or screwed cover plates, flanged ends, etc. shall have removable box type insulation, with same thickness of insulation as for adjacent surfaces. Insulation adjoining such equipment or vessel openings shall be tapered towards these openings to permit removal of bolts, screws, heads, covers or plates with no damage to adjacent surface insulation or cover.

The insulation applied to equipment shall be reinforced with 25 mm (1 inch) 20 SWG galvanised wire netting with hexagonal mesh. One course of wire netting shall be applied to the surface of the equipment, with an additional course per 40 mm of thickness. All irregularities of the surface shall be filled and leveled over with insulating cement. Mineral wool blankets as specified shall be applied over the dry cement surface and secured with annealed wire lacings.

1.5 Refractories

- 1.4 All necessary refractories and setting materials shall be supplied. The refractory bricks supplied shall be of the best quality consistent with temperature obtained at various zones. The refractory and insulation thickness of all sides of the boiler shall be such that the temperature on the surface of the casing would be low enough from the point of view of safety of the operating personnel and also consistent with the permitted heat losses.
- 1.4 On the refractory portion of the boiler walls necessary access doors and observations ports shall be provided. Boiler surfaces which are to be insulated shall have insulation lugs fitted.
- 1.4 Where castable refractories are used special care shall be taken to see before it is applied that its 'shelf life' period is not over.
- 1.4 Necessary anchors for supporting the castable refractory to be provided and the same shall be coated with bitumen paint to allow for differential expansion of anchors and refractory. All parts of tubes and drums to which the castable refractory is applied shall be coated with aluminium or bitumen paint and allowed to dry thoroughly before refractory is applied.

**TABLE 1 - RECOMMENDED MINIMUM THICKNESS FOR
THERMAL INSULATION (MINERAL WOOL)**

NOMINAL DIA IN MM	OPERATING TEMPERATURE (°C)								
	100	150	200	250	300	350	400	450	520
15	25	25	40	40	50	60	75	90	100
20	25	25	40	50	60	60	90	90	115
25	25	25	40	50	60	60	90	100	115
40	25	40	40	50	60	65	90	115	150
50	25	40	40	60	75	75	100	115	150
65	25	40	40	60	75	75	100	115	150
80	40	40	50	60	75	90	100	125	150
100	40	40	50	60	75	90	115	125	150
150	40	50	50	75	75	100	115	150	175
200	40	50	60	75	75	100	125	150	175
250	40	50	60	75	75	115	125	150	175
300	40	60	60	75	80	115	150	175	200
350	50	60	65	75	80	115	150	175	200
400	50	60	75	75	85	115	150	175	200
450	50	60	75	90	90	115	150	175	200
	100	150	200	250	300	350	400	450	520
500	50	60	75	90	90	115	150	175	200
550	60	60	75	90	90	115	150	175	200
600	60	65	80	95	95	115	150	175	200
ABOVE 600 and for flat surfaces	60	65	80	95	95	115	150	175	200