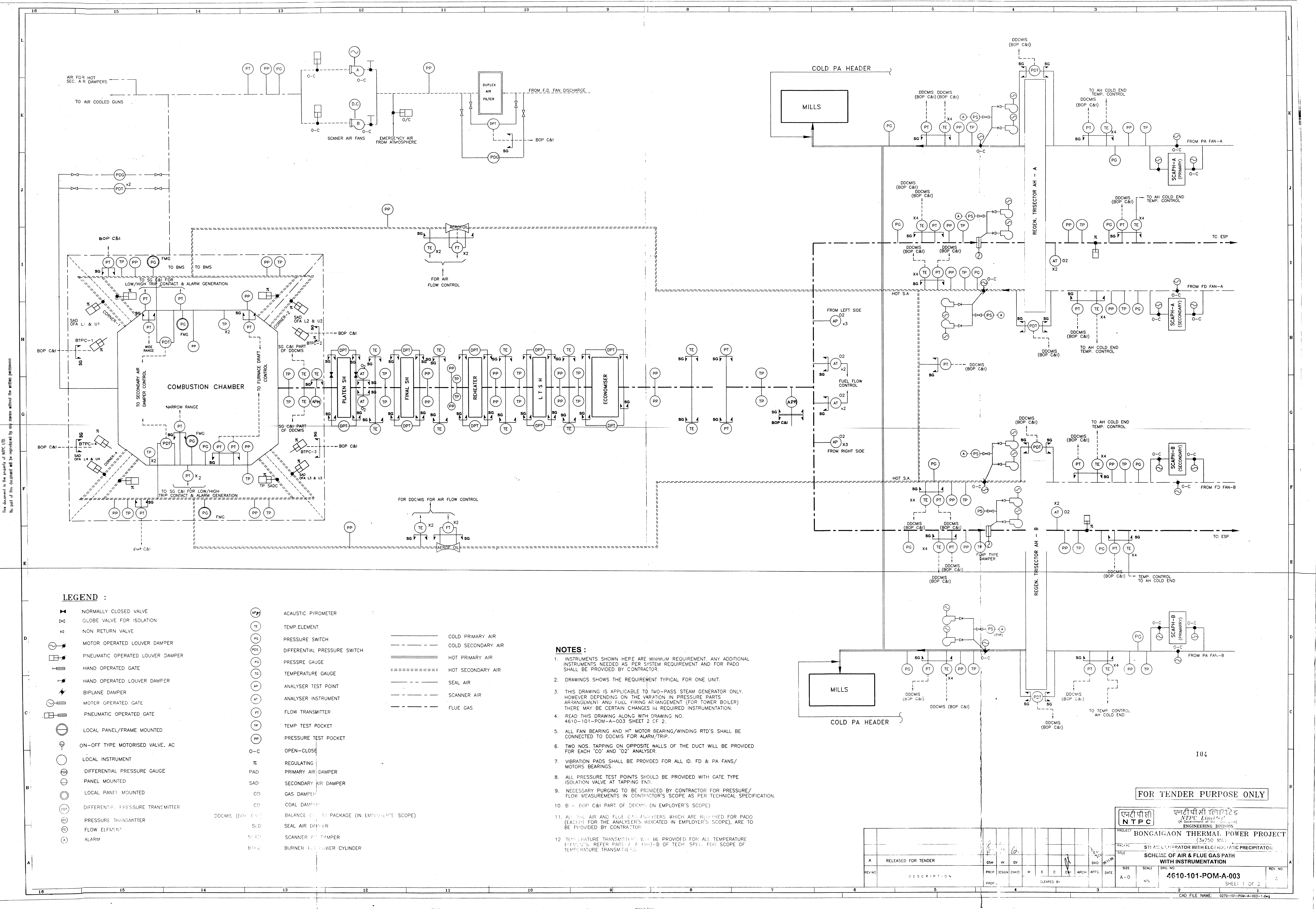




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LEGEND :

	NORMALLY CLOSED VALVE		ACOUSTIC PYROMETER
	GLOBE VALVE FOR ISOLATION		TEMP. ELEMENT
	NON RETURN VALVE		PRESSURE SWITCH
	MOTOR OPERATED LOUVER DAMPER		DIFFERENTIAL PRESSURE SWITCH
	PNEUMATIC OPERATED LOUVER DAMPER		PRESSURE GAUGE
	HAND OPERATED GATE		TEMPERATURE GAUGE
	HAND OPERATED LOUVER DAMPER		ANALYSER TEST POINT
	BIPLANE DAMPER		ANALYSER INSTRUMENT
	MOTOR OPERATED GATE		FLOW TRANSMITTER
	PNEUMATIC OPERATED GATE		TEMP TEST POCKET
	LOCAL PANEL/FRAME MOUNTED		PRESSURE TEST POCKET
	ON-OFF TYPE MOTORISED VALVE, AC		OPEN-CLOSE
	LOCAL INSTRUMENT		REGULATING
	DIFFERENTIAL PRESSURE GAUGE		PRIMARY AIR DAMPER
	PANEL MOUNTED		SECONDARY AIR DAMPER
	LOCAL PANEL MOUNTED		GAS DAMPER
	DIFFERENTIAL PRESSURE TRANSMITTER		COAL DAMPER
	PRESSURE TRANSMITTER		BALANCE COIL AIR PACKAGE (IN EMPLOYER'S SCOPE)
	FLOW ELEMENT		SEAL AIR DAMPER
	ALARM		SCANNER AIR DAMPER
			BURNER FUEL POWER CYLINDER

NOTES :

- INSTRUMENTS SHOWN HERE ARE MINIMUM REQUIREMENT. ANY ADDITIONAL INSTRUMENTS NEEDED AS PER SYSTEM REQUIREMENT AND FOR PADO SHALL BE PROVIDED BY CONTRACTOR.
- DRAWINGS SHOWS THE REQUIREMENT TYPICAL FOR ONE UNIT.
- THIS DRAWING IS APPLICABLE TO TWO-PASS STEAM GENERATOR ONLY. HOWEVER DEPENDING ON THE VARIATION IN PRESSURE PARTS ARRANGEMENT AND FUEL FIRING ARRANGEMENT (FOR TOWER BOILER) THERE MAY BE CERTAIN CHANGES IN REQUIRED INSTRUMENTATION.
- READ THIS DRAWING ALONG WITH DRAWING NO. 4610-101-POM-A-003 SHEET 2 OF 2.
- ALL FAN BEARING AND HT MOTOR BEARING/WINDING RTD'S SHALL BE CONNECTED TO DDCMIS FOR ALARM/TRIP.
- TWO NOS. TAPPING ON OPPOSITE WALLS OF THE DUCT WILL BE PROVIDED FOR EACH 'CO' AND 'O2' ANALYSER.
- VIBRATION PADS SHALL BE PROVIDED FOR ALL ID, FD & PA FANS/MOTORS BEARINGS.
- ALL PRESSURE TEST POINTS SHOULD BE PROVIDED WITH GATE TYPE ISOLATION VALVE AT TAPPING END.
- NECESSARY PURGING TO BE PROVIDED BY CONTRACTOR FOR PRESSURE/ FLOW MEASUREMENTS IN CONTRACTOR'S SCOPE AS PER TECHNICAL SPECIFICATION.
- B - BOP C&I PART OF DDCMIS (IN EMPLOYER'S SCOPE)
- ALL THE AIR AND FLUE GAS ANALYSERS WHICH ARE REQUIRED FOR PADO (EXCEPT FOR THE ANALYSER'S INDICATED IN EMPLOYER'S SCOPE), ARE TO BE PROVIDED BY CONTRACTOR.
- TEMPERATURE TRANSMITTERS WILL BE PROVIDED FOR ALL TEMPERATURE ELEMENTS. REFER PART 2 & PART-B OF TECH. SPEC. FOR SCOPE OF TEMPERATURE TRANSMITTERS.

FOR TENDER PURPOSE ONLY

PROJECT		BONGAIGAON THERMAL POWER PROJECT	
PACKAGE		STEAM GENERATOR WITH ELCTRICAL PRECIPITATOR	
TITLE		SCHEME OF AIR & FLUE GAS PATH WITH INSTRUMENTATION	
REV. NO.		A-0	
DESCRIPTION		4610-101-POM-A-003	
PREP.		DATE	
DESIGN		DATE	
CHKD.		DATE	
APPD.		DATE	
Cleared by		DATE	
Scale		1:1	
NTS		SHEET 1 OF 2	

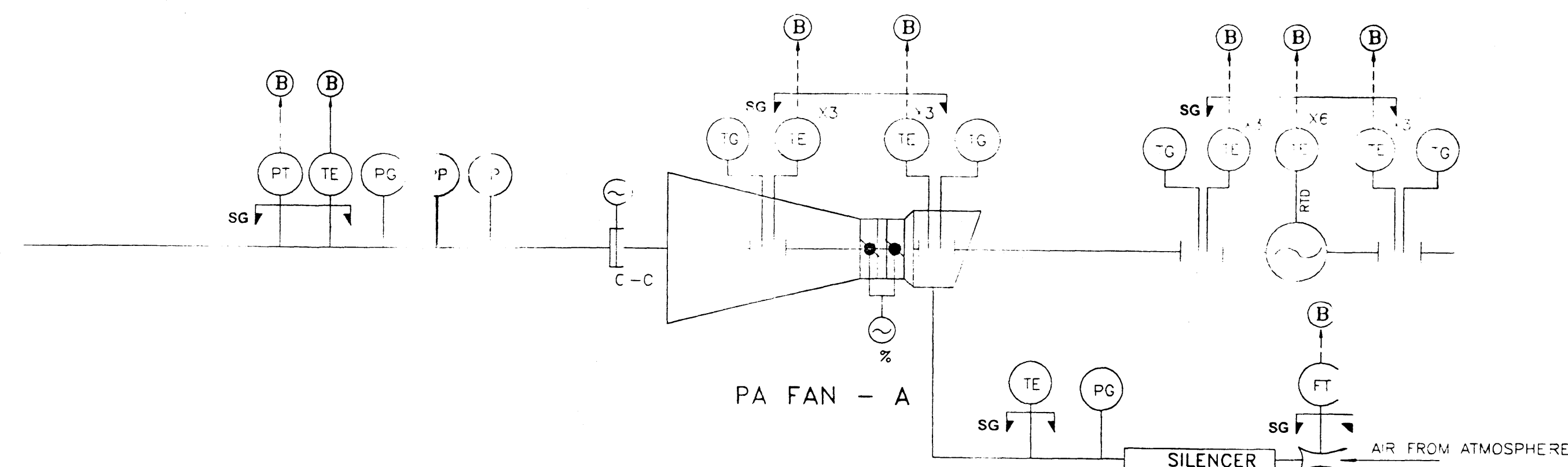
TO AIR HEATER - A
FOR CONTINUATION REFER DRG. NO. 4610-101-POM-A-003 SHEET 1 OF 2
"SCHEME OF AIR & GAS PATH WITH INSTRUMENTATION"

TO MILLS

FROM AIR HEATER - A
FOR CONTINUATION REFER DRG. NO. 4610-101-POM-A-003 SHEET 1 OF 2

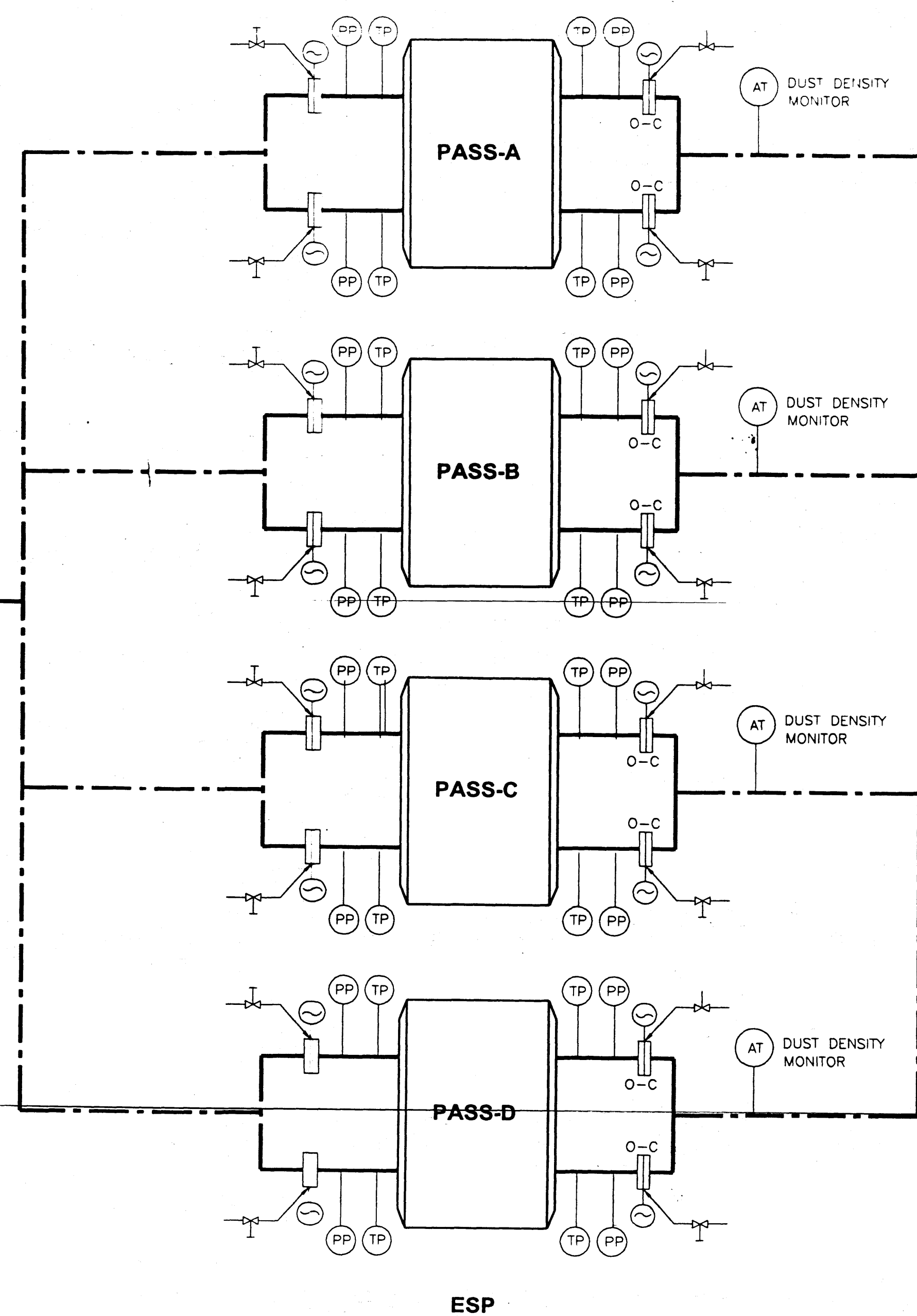
FROM AIR HEATER - B
FOR CONTINUATION REFER DRG. NO. 4610-101-POM-A-003 SHEET 1 OF 2

TO AIR HEATER - B
FOR CONTINUATION REFER DRG. NO. 4610-101-POM-A-003 SHEET 1 OF 2
"SCHEME OF AIR & GAS PATH WITH INSTRUMENTATION"

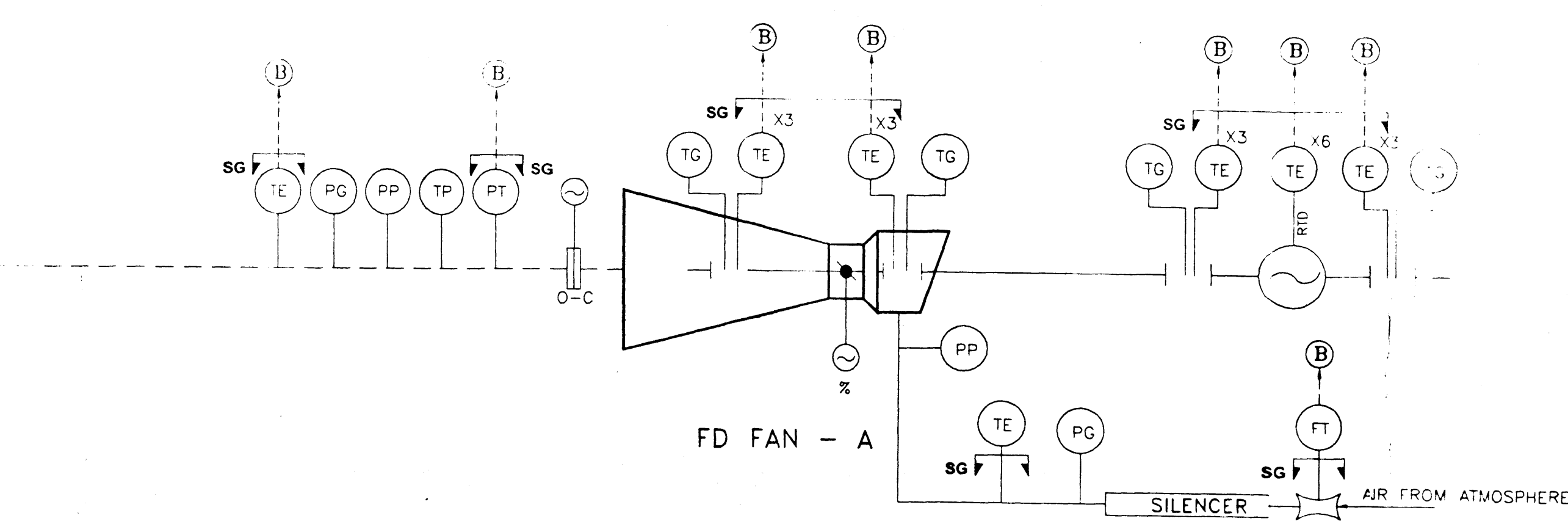


TO AIR HEATER - A
FOR CONTINUATION REFER DRG. NO. 4610-101-POM-A-003 SHEET 1 OF 2

TO SCANNER AIR FANS

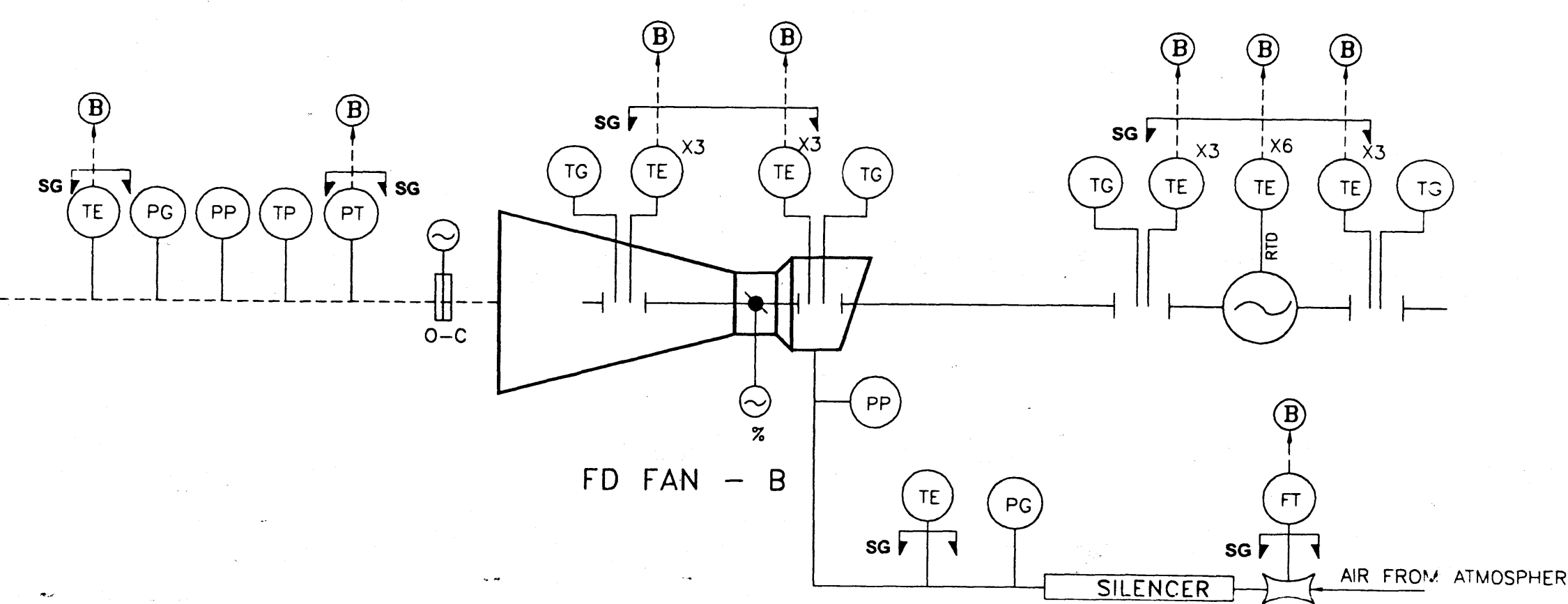
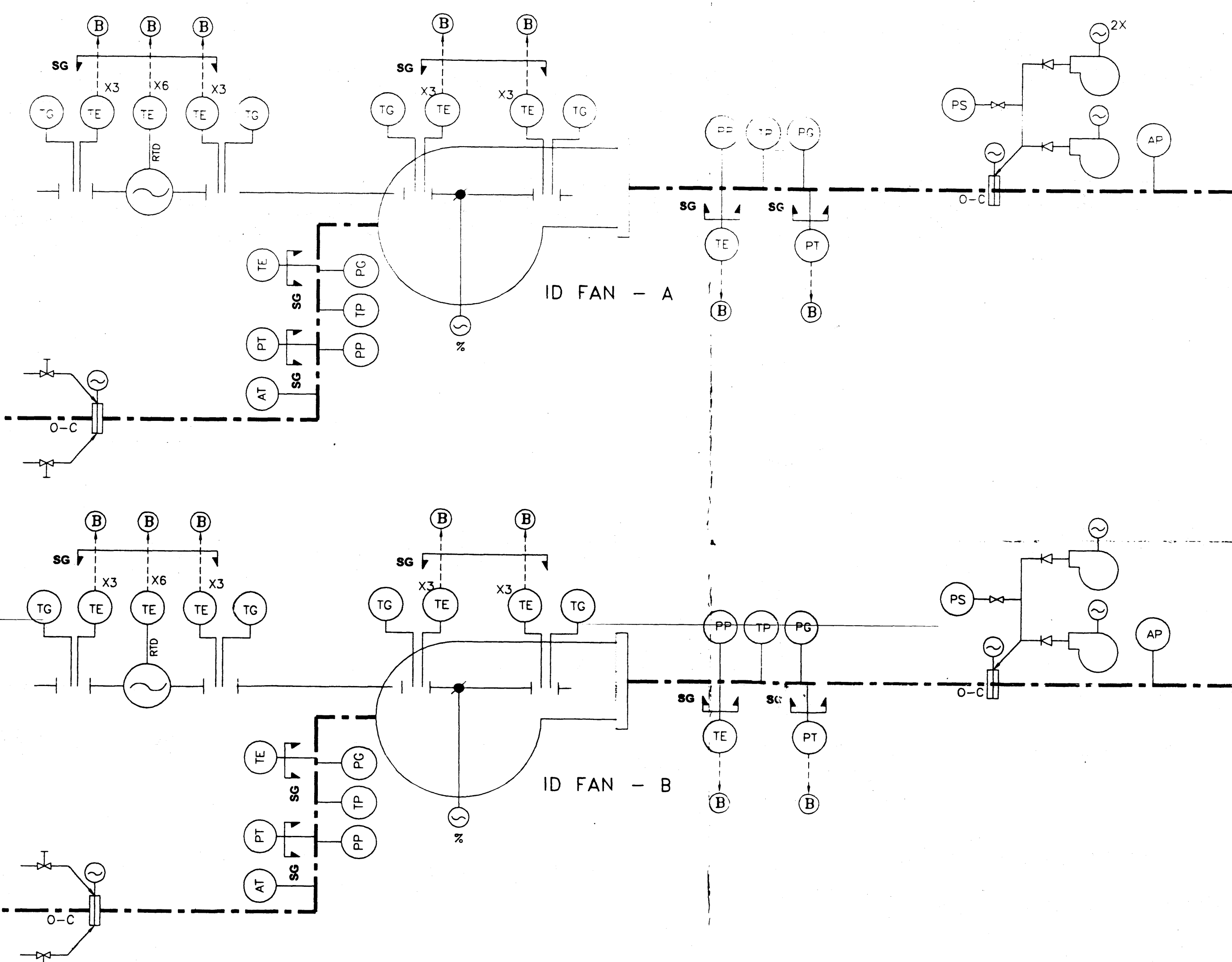


TO AIR HEATER - B
FOR CONTINUATION REFER DRG. NO. 4610-101-POM-A-003 SHEET 1 OF 2



FOR FLUE GAS DESULPHURISATION SYSTEM
REFER DRG. NO. 4610-101-POM-A-006

FROM UNIT NO. 1



NOTES :

1. READ THIS DRAWING ALONGWITH DRAWING NO. 4610-101-POM-A-003 SHEET 1 OF 2.
2. INSTRUMENTS SHOWN HERE ARE MINIMUM REQUIREMENT. ANY ADDITIONAL INSTRUMENTS NEEDED AS PER SYSTEM REQUIREMENT AND FOR PADO SHALL BE PROVIDED BY CONTRACTOR.
3. DRAWING SHOWS THE REQUIREMENT TYPICAL FOR ONE UNIT.
4. ALL PRESSURE MEASUREMENTS/TEST POINTS SHOULD BE PROVIDED WITH GATE TYPE ISOLATION VALVE AT TAPPING END.
5. B - BOP C&I PART OF DDCMIS (IN EMPLOYER'S SCOPE).
6. ALL THE AIR AND FLUE GAS ANALYSER WHICH ARE REQUIRED FOR PADO (EXCEPT FOR THE ANALYSER'S INDICATED IN EMPLOYER'S SCOPE) ARE TO BE PROVIDED BY CONTRACTOR.
7. TEMPERATURE TRANSMITTERS WILL BE PROVIDED FOR TEMPERATURE ELEMENTS. REFER PART-A & PART-B OF TECH. SPEC. FOR SCOPE OF TEMPERATURE TRANSMITTERS.

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FOR TENDER PURPOSE ONLY

PROJECT		BONGAIGAON THERMAL POWER PROJECT	
PACKAGE		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR	
TITLE		SCHEME OF AIR & FLUE GAS PATH WITH INSTRUMENTATION	
REV. NO.		A-0	
DESCRIPTION		4610-101-POM-A-003	
PREP. DESIGN CHKD. M E C C&I ARCH. APPD. DATE		SHEET 20F2	
Cleared by		A	

SECTION - III

BID DATA SHEET (BDS)

STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW)

The following bid specific data for the Plant & Equipment to be procured, shall amend and/or supplement the provisions in the Instructions to Bidders (ITB). Whenever there is a conflict, the provisions herein shall prevail over those in the ITB.

Invitation for Bids (IFB) No. : CS-4610-101-2

BDS Item No.	ITB Clause Ref., if any	Data
1.	ITB 1.1	A. INTRODUCTION Name of the Package : Steam Generator with Electrostatic Precipitator Package for Bongaigaon Thermal Power Project (3x250 MW)
2.	ITB 5.1	B. THE BIDDING DOCUMENTS Address of Employer : DGM (CS/Th-I) NTPC Limited, 6th Floor, Engg. Office Complex, Plot A-8A, Sector 24, Noida-201301 Distt. Gautam Budh Nagar, State of U.P. India Telephone No. 0091-120 - 2596671 / 2410522 / 2596689 Fax No. 0091-120 - 2410359/ 2410284 / 2410011 Add a new sub clause as follows :
3.	ITB 5.1	"Pre-Bid Conference The Bidder or his authorised representative is invited to attend pre-bid conference which will take place at the following address: Address mentioned at Item No. 2 above The pre-bid conference shall be arranged on 22.05.2007 at 1030 AM onwards.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS) PAGE 1 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
		The purpose of the conference will be to clarify any issue regarding the Bidding Documents. The Bidder is requested to submit questions in writing or by fax to reach the Employer at the address indicated above, not later than fifteen (15) days before the pre-bid conference. Record notes of the pre-bid conference including the Employer's responses to the queries raised by the bidders in writing shall be transmitted to all the prospective bidders who have purchased the bidding documents. Further, any modifications of the Bidding Documents which may become necessary as a result of the pre-bid conference shall be made by the Employer exclusively through an amendment to the bidding documents and not through the record notes of the pre-bid conference. Non-attendance at the pre-bid conference will not be a case for disqualification of a bidder. After pre-bid conference, bidders may seek further clarifications, if necessary, provided such clarifications are sought not later than 28 days prior to last date of submission of bids." C. PREPARATION OF BIDS
4.0	ITB 8.3 (c)	Qualifying requirement for Bidders.
4.1		In addition to the requirements stipulated under section ITB, the bidder should also meet the qualifying requirements stipulated hereunder in clauses 4.1.1 or 4.1.2 or 4.1.3, as the case may be, and as per clause 4.2.0: 4.1.1 The Bidder should have designed, engineered, manufactured, erected/supervised erection and commissioned/supervised commissioning of at least one (1) no. of coal fired steam generator of capacity 675 tonnes of steam per hour or above, of the type specified (i.e. Drum type with single pass (tower type) or two pass type) with reheat and which is in successful operation for a period of not less than one (1) year as on the date of bid opening. The bidder shall offer only the type of steam generator for which he is qualified. 4.1.2 4.1.2(a) The Bidder shall be either an Engineering, Procurement
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 2 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
		and Construction (EPC) organization or a Turnkey Management and Contracting organization executing fossil fuel fired power plants and has engineered/got engineered, supplied, erected and commissioned at least two (2) nos. fossil fuel fired thermal units (one each at two separate stations) consisting of stean generator along with associated auxiliary equipments of at least 200 MW unit capacity, on a turnkey basis (with or without civil works), which are in successful operation for a period of not less than two (2) years as on date of bid opening. 4.1.2(b) In addition to the above, the Bidder shall associate/ collaborate with a steam generator manufacturer who meets the requirements of 4.1.1 above on his own and sources the steam generator from such associate/ collaborator. Further, the bidder shall offer only the type of steam generators (i.e. Drum type with single pass (tower type) or two pass type) with reheat for which his associate/collaborator is qualified. The Bidder shall along with the bid furnish an undertaking jointly executed by him and the steam generator manufacturer for the successful performance of steam generator and associated auxiliary equipments, as per the format enclosed in the bidding documents in which the steam generator manufacturer and the bidder are jointly and severally liable to the Employer to perform all the contractual obligations including the technical guarantees for the complete steam generator and associated auxiliary equipments. The deed of joint undertaking shall be submitted along with the bid, failing which the bidder shall be disqualified and his bid shall be rejected. In case of award, the steam generator manufacturer will be required to furnish an on demand bank guarantee for 5% of the contract price of Steam Generator with Electrostatic Precipitator package in addition to the contract performance security to be furnished by the bidder. 4.1.2(c) Bidder who by himself has not carried out the engineering of the reference plants as per the requirements stipulated above shall additionally associate/collaborate with an architect engineering firm/ design institute currently in the field of engineering fossil fuel fired reheat type power plants and who has carried out engineering of steam generator set alongwith associated auxiliary equipments for at least
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 3 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
		two (2) nos. of coal fired reheat type units, with minimum unit rating of 200 MW each (one each at two separate stations), which are in successful operation for a period of not less than two (2) years as on the date of bid opening. Further, the Bidder shall along with the bid furnish an undertaking jointly executed by him and the architect engineering firm/design institute for the successful performance of the services included in the scope of the architect engineering firm/design institute as per the format enclosed in the bidding documents, failing which the Bidder shall be disqualified and his bid shall be rejected. In case of award, the architect engineering firm/design institute will be required to furnish an on demand bank guarantee for 0.05% of the contract price of the Steam Generator with Electrostatic Precipitator package in addition to the contract performance security to be furnished by the Bidder. 4.1.3 4.1.3(a) The Bidder should have been leader of a consortium who has collectively executed a contract meeting requirements stipulated at clause 4.1.1 in a reference plant. Further, for the present bid, the bidder shall associate with the same firm who has designed as well as manufactured the steam generator for the reference plant such that the Bidder along with his associate collectively meets the requirements of clause 4.1.1. The bidder along with his associate shall offer only the type of steam generator i.e. Drum type with single pass (tower type) or two pass with reheat type as in the reference plant. 4.1.3(b) In addition to the above, the bidder shall along with the bid furnish an undertaking jointly executed by him and his associate for the successful performance of steam generator and its auxiliary equipments, as per the format enclosed in the bidding documents in which the associate and the bidder are jointly and severally liable to the Employer to perform all the contractual obligations including the technical guarantees for the complete steam generator and its auxiliary equipments. The deed of joint undertaking shall be submitted along with the bid, failing which the bid shall be disqualified and his bid shall be rejected. In case of award, the associate will be required to furnish an on demand bank guarantee for
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 4 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
4.2		5% of the total contract price of Steam Generator with Electrostatic Precipitator package in addition to the contract performance security to be furnished by the Bidder. 4.1.3(c) The Bidder who by himself has not carried out the engineering of the reference plant shall additionally associate with an architect engineering firm/design institute meeting requirements stipulated at clause 4.1.2(c) above. Notes to clause 4.1.1, 4.1.2 & 4.1.3: (i) Wherever the term 'coal fired' is appearing above, "coal" shall be deemed to also include bituminous coal/sub-bituminous coal/brown coal/lignite. (ii) Where "erection/supervision of erection" and "commissioning /supervision of commissioning" has not been in the scope of the bidder as mentioned in clause 4.1.1, he should have acted as an advisor for erection and commissioning of the Steam Generator and auxiliaries. Necessary documents/certificates from the client, in support of above shall be furnished with the bid. Note to clause 4.1.1 : The bidder shall also be considered qualified, in case the award for the reference works (Steam generator) has been received by the bidder either directly from owner of plant or any other intermediary organisation. However, a certificate from such owner of plant or the intermediary organisation shall be required to be furnished by the bidder along with his bid in support of his claim of meeting the qualification requirement as per 4.1.1 above, as the case may be. Further, certificate from owner of the plant shall also be furnished by the bidder for the successful operation of the Steam generator as specified at clause 4.1.1. 4.2.0 Financial requirements a) The Net Worth of the bidder as on the last day of the preceding financial year shall not be less than 25% of the paid-up share capital.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 5 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
		A bidder who does not satisfy the net worth criteria, stipulated in clause 4.2.0 (a) above on its own would be required to furnish along with its bid, a letter of Undertaking from the holding company pledging unconditional and irrevocable financial support for the execution of the Contract by the bidder in case of award, provided that the net worth of such holding company as on the last day of the preceding financial year should be at least equal to more than the paid-up share capital of the holding company. In cases where audited results for the last preceding financial years are not available, certification of financial statements from a practicing Chartered Accountant shall also be considered acceptable. b) The average annual turnover of the bidder, in the preceding three (3) financial years as on the date of bid opening, shall not be less than Rs.3232 million or in equivalent foreign currency c) The unutilized Bank Guarantee limits of the bidder, as on 7 (seven) days prior to the date of bid opening, duly certified by the Bankers, shall not be less than Rs. 3454 million or in equivalent foreign currency. d) The bidder shall have unutilized cash credit limits together with cash and bank balances including fixed deposits, as on the 7 (seven) days prior to the date of bid opening, of not less than Rs.808 million or in equivalent foreign currency. e) In case the bidder's unutilized bank guarantee / cash credit limits (stipulated at 4.2.0(c) & 4.2.0(d) above are not sufficient, a comfort letter from one of the bankers specified in the bidding documents unequivocally stating that in case the bidder is awarded the contract, the Bank would enhance bank guarantee limit / cash credit limit to a level not less than the specified amounts, shall be acceptable.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 6 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
		Notes for clause 4.2.0: a) Net Worth means the sum total of the paid up share capital and free reserves. Free reserves means all reserves credited out of the profits and share premium account but does not include reserves credited out of the revaluation of assets, write back of depreciation provisions and amalgamation. Further, any debit balance of profit and loss account and miscellaneous expenses to the extent not adjusted or written of, if any, shall be reduced from Reserves & Surplus. b) Other income shall not be considered for arriving at annual turnover. c) For unutilized BG limits, Cash Credit Limits and Turnover indicated in foreign currency, the exchange rate as on 7 (seven) days prior to the date of bid opening shall be used .
4.3		Bids not meeting the requirements as stated above shall be rejected.
4.4		Bidders are required to furnish the details of the past experience based on which selection is to be made as per formats enclosed in the bidding documents for the same and enclose relevant documents like copies of authentic work order, completion certificate, agreements, etc. supporting the details/ data provided in the format. No claims without supporting documents shall be accepted in this regard.
4.5		The Employer also reserves the right to assess the capacity and capability of the bidder/ collaborator/ proposed assignee to satisfactorily execute the contract. Such assessment shall include, but not be limited to, the evaluation of adequacy of facilities, services, resources, design/engineering capacity and financial capability.
4.6	8.3 (c)	Whether Joint Ventures/Consortium are permitted : NO
5.0	ITB 12.1	(a) Amount of Bid Security:Equivalent to Rs. 245 Million in currency of bid or US Dollars. If the bid price is quoted in more than one currency, the Bid security shall be in US Dollars.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS) PAGE 7 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
5.1	ITB 12.2	The bills selling exchange rate used by the bidder's bank as on the date of execution of the bid security shall be used for arriving at the amount of bid security in currency of bid / US Dollars. A certificate issued by the bidder's bank mentioning the Bills selling exchange rate used by the bidder's bank as on the date of execution of the bid security shall be submitted by the bidder with the bid security in Attachment-1. (b) Period of validity of Bid Security : 45 days beyond expiry of the validity of bid, i.e., 225 days from the date of bid opening. In case of domestic bidders, the Bank Guarantee for Bid Security shall be from a Bank as listed in Annexure-I to this Section-III. In case of foreign bidders, if the bank guarantee is from a bank not specified in the aforesaid list, the bank guarantee shall be confirmed by any such bank as specified in the list.
6.	ITB 16.1	D. SUBMISSION OF BIDS Address to which Bids shall be submitted: R.K. Gupta, DGM / Ashok Kumar, Sr. Manager Contract Services (Thermal-I) NTPC Limited, 6th Floor, Engg. Office Complex, Plot A-8A, Sector 24, Noida-201 301 Distt. Gautam Budh Nagar, State of U.P. India
7.	ITB 16.1	Deadline for Bid Submission-1030 hrs. (IST) on date as stated in IFB. E. BID OPENING AND EVALUATION
8.	ITB 19.1	Location of Bid Opening Contract Services (Thermal-I) NTPC Limited, 6th Floor, Engineering Office Complex, A-8A, Sector-24, NOIDA-201 301 Distt. Gautam Budh Nagar State of U.P. INDIA
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 8 OF 18

BDS Item No.	ITB Clause Ref., if any	Data																									
9.	ITB 22.1 & ITB 24.3 (c)	Time for Bid Opening	1100 hrs. (IST)																								
		Date for Bid Opening	as stated in IFB																								
		Currency chosen for : purpose of evaluation	Indian Rupees																								
		Type of Transaction : and Source of exchange rate	Bills Selling Exchange Rate established by STATE BANK OF INDIA																								
		Date of exchange rate :	Date of opening of bids																								
10.	ITB 24.3 (b)	Time to complete the facilities from the date of Notification of Award :																									
10.1		The programme for supplying, installing, commissioning, completing the facilities and FOR site delivery of all mandatory spares covered in the package shall be in the form of Master Network identifying the Key phases in various areas of total works, like design, procurement, manufacture and field activities including erection works. In addition, key milestone dates (10-15 nos.) shall also be identified for the complete facilities under the subject package. The Master Network shall conform to the following schedule dates for the key milestones of Unit-I, Unit-II & Unit-III. <table> <tr> <th>Sl.No.</th><th>Activity</th><th>% of Completion Boiler Tonnage</th><th>Months from the date of Notification of Award (NOA)</th></tr> <tr> <td>1.</td><td>Completion of Detailed Engineering</td><td>---</td><td>19</td></tr> <tr> <td>2.</td><td>Commencement of manufacturing</td><td>---</td><td>04</td></tr> <tr> <td>3.</td><td>Commencement of Supplies (Foundation Material)</td><td>---</td><td>04</td></tr> <tr> <td>4.</td><td>Commencement of Supplies (Balance)</td><td>---</td><td>05</td></tr> <tr> <td>5.</td><td>Start of Boiler Erection</td><td>---</td><td>09</td></tr> </table>		Sl.No.	Activity	% of Completion Boiler Tonnage	Months from the date of Notification of Award (NOA)	1.	Completion of Detailed Engineering	---	19	2.	Commencement of manufacturing	---	04	3.	Commencement of Supplies (Foundation Material)	---	04	4.	Commencement of Supplies (Balance)	---	05	5.	Start of Boiler Erection	---	09
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		PAGE 9 OF 18																									

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BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)		PAGE 10 OF 18																																																													

BDS Item No.	ITB Clause Ref., if any	Data
10.2		The above schedule is for Unit-I only. The Phasing between various activities of Unit-I, Unit-II and Unit-III shall be four months except for Engineering activities. Further, all engineering data related to civil input, interface engineering details, requiring NTPC's approval/information for the Employer scope items are to be given within the agreed schedule but in no case later then 45 days from placement of this order. For Bought Out Items, the engineering input data shall be given to NTPC within the agreed schedule but in on case later than 45 days from placement of respective purchase order to their sub vendor. Bidder shall also be required to submit a brief integrated PERT Network (Master Network / L1 Schedule) matching with above Time Schedule. The Master Network shall include the major activities listed at (i) below for each of the systems given at (ii) below showing their inter-relationship and duration so as to meet the schedule dates mentioned at 10.1 above. : (i) Milestones to be incorporated in Master Network (L1 Schedule) to be submitted with bid : 1. Ordering on sub vendor (wherever applicable) 2. Start of engineering 3. Completion of engineering 4. Start of manufacturing/fabrication 5. Completion of manufacturing/fabrication 6. Commencement of despatch 7. Completion of despatch 8. Commencement of Civil Work (wherever applicable) 9. Start of erection 10. Commissioning of the system
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
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BDS Item No.	ITB Clause Ref., if any	Data
10.3		(ii) Milestones at (i) above are to be indicated for each system covered in the scope bidder such as : 1. Power Cycle Piping 2. Electrostatic Precipitator 3. Fuel Oil System 4. Chemical Dosing System 5. Associated Electrical & C&I System 6. Boiler Area Elevators etc. The master network and the key milestone dates will be discussed with the successful bidder and agreed upon before the issue of Notification of Award. Engineering Drawing and Data Submission Schedule shall also be discussed and finalised before the issue of Notification of Award.
10.4		After the Notification of Award, the contractor shall plan the sequence of work of manufacture, supply and installation to meet the above stated dates of successful completion of facilities and shall ensure all work, manufacture, shop testing, inspection and shipment of the equipment in accordance with the required sequence.
11.		ITB 24.3 (c) (ii) Functional Guarantees
11.1		For the purpose of evaluation & comparison of Bids, the adjustment factors as detailed below shall apply : (1) The guaranteed values without any tolerance for the various identified parameters as declared by the Bidders in their bids shall be considered for the purposes of Bid Evaluation. The values of adjustment factors for bid evaluation for various characteristics on a per unit basis, have been brought out below. (2) The best of the parameters quoted by any Bidder (i.e. in Attachment-10A) shall be taken as the base and the differential between this and those quoted by other Bidders, multiplied by the adjustment factors for bid evaluation and the number of units shall be used to arrive at the differential price to be applied for the bid. The differential price for each unit shall be the sum of all the adjustment factors from 11.2 (i) to (vi) given below
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS)
		PAGE 12 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
		under "ADJUSTMENT FACTORS FOR BID EVALUATION". Unless and otherwise specified the adjustment factors given below shall be pro-rated for fractional parts of the differential determined. (3) The bidders attention is drawn to the following sub-clauses (a) through (e) with regard to Output of Steam Generator capacity, Coal Pulveriser Grinding Elements Wear Life, NOx Emission, SOx Emission and Electrostatic Precipitator (ESP) efficiency: (a) Steam Generator Capacity It may however be noted that Bids guaranteeing/ offering lower values for steam generator capacity than that specified in the technical specification (clause no. 1.03.00 sub-section-IIM-01, Part-B, Section-VI of Bidding Documents) for the steam generating capacity output (steam flow at super-heater outlet) shall run the risk of rejection. Further, the bids offering steam generating capacity of steam generators higher than that specified in the technical specification shall also not be given any evaluation credit. (b) Coal pulveriser Grinding Elements Wear life The guaranteed wear life for the grinding elements of coal pulverisers offered shall not be less than 5500 hrs for whole range of specified coal(s). Bids guaranteeing/offering coal pulveriser grinding elements with wear life lower than 5500 hrs. shall run the risk of rejection. Further, bids offering better values for the coal pulveriser grinding elements wear life, than that specified in the technical specifications i.e., 8000 hrs. shall also not be given any evaluation credit. (c) NOx Emission Bids, guaranteeing/offering total NOx emission levels from the Steam Generator higher than maximum emission limit of 260 gms of NOx (from thermal as well as fuel) per Gigajoule (Gj) of heat input to the boiler during the entire operating range of Steam Generator for the range of coals specified, shall not be considered for evaluation and are liable to be rejected.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS) PAGE 13 OF 18

BDS Item No.	ITB Clause Ref., if any	Data												
11.2		(d) Electrostatic Precipitator (ESP) Bid guaranteeing/offering Electrostatic Precipitator (ESP) efficiency lower than that required to achieve the outlet dust burden of 31mg/Nm³ under guarantee point conditions as specified in clause 11.00.00, Sub Section-II:M-03, Part-B, Section-VI of Bidding Documents shall not be considered for evaluation and are liable to be rejected. (e) SO_x Emission Bids guaranteeing/offering Flue gas desulphurization system (FGD) efficiency lower than the guarantee requirement of 95% under guarantee point conditions as specified in the relevant clause of Sub-Section-II:M-4, Part-B, Section-VI of Bidding Documents shall not be considered for evaluation and are liable to be rejected. ADJUSTMENT FACTORS FOR BID EVALUATION The adjustment factors per steam generator shall be as indicated below : <table border="1"> <thead> <tr> <th>Sl. No.</th><th>Guarantee</th><th>Amount of Bid Evaluation Factor (BEF)</th></tr> </thead> <tbody> <tr> <td>(i)</td><td>Steam Generator Efficiency</td><td></td></tr> <tr> <td></td><td>For Steam Generator efficiency guaranteed in percentage points under conditions stipulated in clause 3.01.00 (i) of Sub-Section-VI, Part-A, Section-VI of Technical Specification.</td><td></td></tr> <tr> <td>a)</td><td>100% TMCR (250 MW unit load) under conditions stipulated in clause 3.01.00 (i)(a) of Sub-Section-VI, Part-A, Section-VI of Technical Specification</td><td>US \$ 456,696/- (US dollar Four hundred Fifty Six thousand Six hundred ninety six only) for every 0.1% differential in efficiency from base value</td></tr> </tbody> </table>	Sl. No.	Guarantee	Amount of Bid Evaluation Factor (BEF)	(i)	Steam Generator Efficiency			For Steam Generator efficiency guaranteed in percentage points under conditions stipulated in clause 3.01.00 (i) of Sub-Section-VI, Part-A, Section-VI of Technical Specification.		a)	100% TMCR (250 MW unit load) under conditions stipulated in clause 3.01.00 (i)(a) of Sub-Section-VI, Part-A, Section-VI of Technical Specification	US \$ 456,696/- (US dollar Four hundred Fifty Six thousand Six hundred ninety six only) for every 0.1% differential in efficiency from base value
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BDS Item No.	ITB Clause Ref., if any	Data
12.	ITB 33.1	Grinding element consumption rate for bid evaluation purposes shall be worked out based on design blended coal firing at 100% TMCR load (250 MW unit load). Grinding element wear life guaranteed by the bidder shall be considered for these calculations. The life and cost of the bowl/rings and grinding balls/rollers/tyres etc. shall be evaluated on per steam generator basis as follows: $A = \frac{7008 \times \text{Number of mills working at 250 MW unit load with design blended coal}}{0.15909} \times \text{Cost of one set of bowl rings for one mill}$ $B = \frac{7008 \times \text{Number of mills working at 250 MW unit load with design blended coal}}{0.15909} \times \text{Cost of one set of rollers tyres/grinding balls for one mill}$ Total mill grinding parts evaluated cost = A + B for each steam generator. In the above calculations, the cost of wear parts for the mills shall be those quoted by the bidder for the corresponding parts in the price schedule-10A. The costs shall be the CIF price for foreign supplies and ex-works price for indigenous supplies. The lowest cost of mill grinding parts so worked out for the different bids shall be considered as base and the differential cost for the other bids shall be considered as cost compensation for those bids on account of cost of mill grinding parts. Appointing Authority for Adjudicator under the Contract : CMD, NTPC
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS) PAGE 17 OF 18

BDS Item No.	ITB Clause Ref., if any	Data
13.	ITB 12.6 ITB 32.4	INELIGIBILITY FOR FUTURE TENDER Notwithstanding the provisions specified in ITB sub-clause 12.6 and ITB Sub-Clause 32.4, if a bidder after having been issued the Notification of Award, either does not sign the Contract Agreement pursuant to ITB Clause 31 or does not submit an acceptable Performance Security pursuant to ITB Clause 32, such bidder may be considered ineligible for participating in future tenders of NTPC for a period as may be decided by the Employer.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - III (BDS) PAGE 18 OF 18

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3.	Pre-Bid Conference (New Clause)	1
4.	Preparation of Bids [ITB GCC Clause 8.3(c)]	2
5.	Bid Security	7
6.	Submission of Bids (ITB Clause 15.2)	8
7.	ITB Clause 16.1	8
8.	Bid Opening & Evaluation (ITB Clause 19.1)	8
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13.	Ineligibility for future tenders (ITB Clause 12.6, 31, 32)	18

SECTION - III

BID DATA SHEET

CLAUSE NO.	BIDDER'S NAME		
	CHAPTER-I : FGD TECHNICAL INFORMATION / DATA TO BE SUBMITTED ALONGWITH THE BID		
1.00.00	GENERAL TECHNICAL INFORMATION / DATA DRAWINGS FOR FLUE GAS DESULPHURIZATION SYSTEM		
1.01.00	Performance Data for FGD		
1.01.01	Characteristic/Correction Curves for Absorber		
	i) Gas flow rate vs SO2 removal efficiency ii) Inlet SO2 concentration vs SO2 removal efficiency iii) Inlet dust concentration vs Dust Removal efficiency iv) Gas Flow Rate vs Pressure Drop v) Inlet Gas Temperature vs. Stack Inlet Temperature vi) Gas Flow Rate vs. Stack Inlet Temperature vii) Gas Flow Rate vs. Water Consumption viii) Inlet Gas Temperature vs. Water Consumption ix) Characteristic curves for the Limestone Pulverizer a) Variation of pulverizer capacity with Limestone Bond Index (other conditions to be defined) b) Variation in Pulverizer Capacity with Limestone Output Fineness (other conditions to be defined)		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 1 OF 50			

CLAUSE NO.	BIDDER'S NAME
1.02.00	c) Energy consumption per tonne through put of pulverizer for varying pulverizer output
	x) Characteristic curves of the Recirculation Slurry pumps
	xi) Characteristic curves of the Limestone Slurry pumps
	xii) Characteristic curves of the Gypsum Bleed pumps
	xiii) Characteristic curves of the Mist Eliminator Wash Water Pumps
	xiv) Characteristic curves of the Process Water pumps
	xv) Characteristic curves of the Filter Water pumps
	xvi) Characteristic curves of the Vacuum pumps
	xvii) Characteristic curves of the Sump pumps
	xviii) Characteristic Curves for Hydro-cyclones
	Supplementary Data for FGD System
	i) A complete list of all the equipment requiring the following shall be furnished indicating parameters continuous requirements and the maximum requirement together with schematic diagrams
a) Cooling water	
b) Service air	
c) Instrument air	

BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 2 OF 50

CLAUSE NO.	BIDDER'S NAME
	d) Number and electrical rating of AC power supply feeders at available voltage for each control instrumentation system in Bidder's scope ii) Schedule of power consumption iii) Complete schedule of motors giving voltage, phase, KW rating (calculated and installed capacity), service factor etc. iv) Recommended mode of erection sequence and other relevant particulars in respect of installation of : a) Structural Steel b) Rotating Equipment c) Static Equipment d) Others v) Detailed recommended procedures for welding and erection vi) A comparison and history of all FGDs in service of similar design and size to that proposed including descriptions of operating difficulties. vii) A complete list of local instruments, sensing devices and control equipment covered in the proposal with type, make, accuracy, range, details, dial size etc. in the Bidder's scope. viii) Schedule of control valves giving type and make of valves and actuators, size, body and trim material etc. stroke length, stroking time and full technical particulars of valves and their actuators and associated accessories
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 3 OF 50

CLAUSE NO.	BIDDER'S NAME
	ix) Schedule of dampers and vanes with full particulars of dampers and their actuators, (for powered dampers) such as type of actuator, make, torque rating, stroke and stroking time, electrical rating/ pneumatic consumption limit and torque switch position transmitter details x) List of special maintenance tools included in the proposal xi) List of insert panels, control cabinets and local control panels included in the proposal with GA drawings, mounting and output details xii) List of field mounted junction boxes included in the proposal. xiii) List and details of instruments & control items supplied loose for mounting on control panels, including details like type. make, cutout & drawings etc. xiv) Temperature sensors calibration standards xv) List of annunciations giving suggested set values of parameters List of inputs provided for Data Acquisition System xvi) Particulars of prefabricated & other special cables included in Bidder's scope xvii) Write up on FGD internals including spray system, oxidation system, mist eliminators, supporting structures, etc. xviii) Write up on Absorber Auxiliaries like Slurry recirculation pumps, oxidation compressors, gypsum bleed pumps, agitators etc
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 4 OF 50	

CLAUSE NO.	BIDDER'S NAME			
1.03.00	xix)	Write up on operating procedures and control philosophy		
	xx)	Write up on interlocks and protections		
	xxi)	Detailed calculations for working out of FGD inlet gas flow, gas temperature, inlet SO2 concentration, SO2 removal efficiency, water evaporation, stack inlet temperature, limestone feed and gypsum bleed.		
	xxii)	Detailed sizing calculation for GGH, slurry recirculation pumps, oxidation air compressors, gypsum bleed pumps, oxidation tank capacity		
	xxiii)	Details of manufacturing and erection tolerances for FGD internals.		
	xxiv)	Write up on Limestone Grinding System including mills and all auxiliaries like mill circuit pumps, separator tank, agitators, hydro-cyclones etc		
	xxv)	Write up on Gypsum Dewatering System including Vacuum Belt Filters, hydro-cyclones and all auxiliaries like vacuum receiver, vacuum pump, vacuum breaker, agitators, etc		
	xxvi)	Write up on Waste Water Treatment System including all auxiliaries like hydro-cyclones, pumps, neutralization system, etc		
	xxvii)	Write-up on Handling System for Heavy equipments as per specification		
		Drawings		
	i)	General arrangement drawing (Plan and elevation) with appropriate dimensions		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 5 OF 50

CLAUSE NO.	BIDDER'S NAME			
	ii) Layout of FGD structural steel columns. These shall indicate the size of members and main dimensions, with design loadings and all lifting facilitate for purposes of maintenance. iii) Arrangement of platforms, walkways and galleries iv) Schematic diagram indicating terminal points and instrumentation & controls included in Bidder's scope and suggestive scheme for flue gas system, limestone grinding system and gypsum dewatering system indicating, pipe duct size (OD's and ID's) operating parameters, maximum fluid velocities, water balance, insulation thickness and material specification etc. v) Location plan - Details of location and arrangement scheme of columns embedment and fixing details, size of pedestals, levels blockouts & anchor bolts. and channels indicating scope of supply by equipment supplier vi) Loading on foundations : Axial load, bending moments and shear forces transmitted to foundations of following loading combinations separately. a) Dead load b) Live load c) Wind load d) Seismic load vii) Complete bracing arrangements for FGD supporting structures and combinations of (+v) and (-v) forces for the seismic or wind (whichever is governing) viii) Percentage of live load considered for calculating wind and seismic forces			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 6 OF 50

CLAUSE NO.	BIDDER'S NAME		
1.04.00	ix)	Recommended size and general arrangement of FGD control room in plan and sections along with its location plan.	
	x)	Schedule of heat load for air conditioning	
	xi)	Gas distribution system	
	xii)	Absorber, Slurry spray system, mist eliminator and washing system including support details	
	xiii)	Oxidation Tank and oxidation nozzle including support details and location of agitators, level indicators and other instruments	
	xiv)	Weather proof enclosure and lifting	
	xv)	Schematic diagram controls and diagrams	
	xvi)	Interconnecting wiring diagrams	
	Predicted Performance	Guarantee point Design coal (Blended)	Design point Worst coal (Blended)
	i)	Coal fired (kg/hr.)	
	ii)	Gas Flow at Inlet to GGH (kg/hr.)	
		Gas Flow at Inlet to GGH (m3/hr.)	
		Gas Flow at Inlet to GGH (Nm3/hr.)	
	iii)	Gas Temperature at Inlet to GGH (oC)	
	iv)	Gas Pressure at Inlet to GGH (mmwc)	
	v)	Gas Flow at Inlet to Absorber (kg/hr.)	
		Gas Flow at Inlet to Absorber (m3/hr.)	
		Gas Flow at Inlet to Absorber (Nm3/hr.)	
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	PAGE 7 OF 50

CLAUSE NO.	BIDDER'S NAME			
	vi) Gas Temperature at Inlet to Absorber (oC) vii) Gas Pressure at Inlet to Absorber (mmwc) viii) Gas Flow at Absorber Outlet (kg/hr.) Gas Flow at GGH Cold Gas Outlet (m3/hr.) Gas Flow at GGH Cold Gas Outlet (Nm3/hr.) ix) Gas Temperature at Absorber Outlet (oC) x) Gas Flow at GGH Cold Gas Outlet (kg/hr.) Gas Flow at GGH Cold Gas Outlet (m3/hr.) Gas Flow at GGH Cold Gas Outlet (Nm3/hr.) xi) Gas Temperature at GGH Cold Gas Outlet xii) Gas Pressure at GGH Cold Gas Outlet (mmwc) xiii) Gas Flow at Stack Inlet (kg/hr.) Gas Flow at Stack Inlet (m3/hr.) Gas Flow at Stack Inlet (Nm3/hr.) xiv) Gas Temperature at Stack Inlet (oC) xv) Gas Pressure at Stack Inlet (mmwc) xvi) GGH leakage (kg/hr) xvii) GGH leakage (% of inlet hot gas flow)			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		PAGE 8 OF 50

CLAUSE NO.	BIDDER'S NAME
	xviii) Inlet SO2 concentration (mg/Nm3) xix) Outlet SO2 concentration (mg/Nm3) xx) SO2 removal efficiency (%) xxi) Inlet Dust Burden (mg/Nm3) xxii) Outlet Dust Burden (mg/Nm3) xxiii) Limestone Consumption (kg/hr) xxiv) Ca/S Molar Ratio (Based on Inlet Gas SO2) xxv) Gypsum Produced (kg/hr) xxvi) Oxidation Air Flow (kg/hr.) xxv) Excess Air over stoichiometric requirement (%) xxvi) Water Consumption (m3/hr) a) Mist Eliminator Wash Water b) Make-up Water c) Limestone feed d) Gypsum Carry over e) Waste Water xxvii) Recirculation Slurry Flow (m3/hr) xxviii) Recirculation Slurry Solid Concentration (% w/w) xxix) L/G Ratio xxx) Slurry pH xxxi) Limestone Slurry Solid Concentration (% w/w) xxxii) Gypsum Bleed Solid Concentration (% w/w)
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 9 OF 50

CLAUSE NO.	BIDDER'S NAME					
	xxxiii) SO2 removal efficiency with one spray level out of service (for multiple levels of spray) OR SO2 removal efficiency with one spray pump out of service (for single level spray) xxxiv) Waste Water Analysis xxxv) Lime consumption for waste water neutralization (kg/hr.)					
2.00.00	EQUIPMENT DATA					
2.01.00	Gas Ducts					
		GGH Hot Gas Inlet	GGH to Absorber	Absorber to GGH	Absorber Bypass Duct	GGH to stack
	i)	Cross Sectional Area (m2)	.....	.....	.....	.....
	ii)	Dimensions (m x m x m)	.....	.....	.....	.....
	iii)	Material / Thickness (mm) of Duct	.....	.....	.....	.....
	iv)	Material / thickness (mm) of Lining	.....	.....	.....	.....
	v)	Method of lining (Lining / Cladding / Wallpaper)	.....	.....	.....	.....
	vi)	Estimated Life of liners (hrs.)	.....	.....	.....	.....
	vii)	Max. Velocity through ducts at 100% BMCR (DC/WC/BC whichever gives the max. velocity) (m/s)	.....	.....	.....	.....
2.02.00	Guillotine Gates		Inlet Gate	Outlet Gate		Bypass Gate
	i)	Manufacturer	.....	.....		.....
	ii)	Size (m x m)	.....	.....		.....
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		SUB-SECTION:DM3		PAGE 10 OF 50

CLAUSE NO.	BIDDER'S NAME			
2.03.00	iii)	Material / Thickness of		
	a)	Plate	.....	.....
	b)	Frame	.....	.....
	c)	Seals	.....	.....
	iv)	Actuator Type	.....	.....
	v)	Actuator Rating (KW)	.....	.....
	vi)	Sealing Efficiency (without Seal Air fans) (%)	.....	.....
	vii)	No. of Seal Air Fans provided	.....	.....
	viii)	Sealing Efficiency with Seal Air fans (%)	.....	.....
	ix)	Seal Air Fan Flow / Head (M3/hr./mmwc)	.....	.....
		Absorber		
	i)	Manufacturer	.....	
	ii)	Manufacturer's model number	.....	
	a)	Absorber Cross Sectional Area (m2)	.....	
	b)	Absorber Dimension (mxmxm) (Width x Depth x Height) or (Dia x Height)	.....	
	c)	Oxidation Tank Dimension (mxmxm) (WidthxDepthxHeight) or (Dia x Height)	.....	
	d)	Height between support level to top of support steel (m)	.....	
	iv)	Number of spray levels (Working + Stand-by)	.....	
	v)	Number of spray nozzles per spray level per boiler	.....	
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 11 OF 50

CLAUSE NO.	BIDDER'S NAME		
	vi) Number of redundant spray nozzles per level vii) No. of slurry pumps per spray level viii) Maximum slurry flow (m3/hr) ix) L/G Ratio x) No. of agitators xi) No. of redundant agitaors xii) No. of oxidation nozzles xiii) No. of redundant oxidation nozzles xiv) Guaranteed SO2 removal efficiency (%) xv) Dust Removal Efficiency (%) xvi) Guaranteed pressure drop across Gas System (mmwc) xvii) Guaranteed Stack Inlet Temperature (oC) xviii) Limestone Consumption (kg/hr) xix) Gas velocity through Absorber (M/sec) xx) Gypsum Residence time (sec) in oxidation Tank xxi) Aspect ratio xxii) Proposed standard for conducting the performance tests xxiii) SO2 removal efficiency with one spray level out of service (for multiple levels of spray) OR SO2 removal efficiency with one spray pump out of service (for single level spray)		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3
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CLAUSE NO.	BIDDER'S NAME			
	xxiv) SO2 removal efficiency with max. SO2 concentration (from the range of specified coals) (%) xxv) Slurry pH under conditions xxiv) xxvi) Limestone consumption under conditions xxiv) (kg/hr.) xxvii) Gypsum flow under conditions xxiv) (kg/hr.) xxviii) Material / Thickness (mm) of Base MaterialLining a) Absorber and lining b) Wet Dry Interface and lining c) Oxidation Tank and Lining d) Absorber Inlet Duct and Lining e) Absorber Outlet Duct and Lining f) Mist Eliminators g) Mist Eliminator Was Water Header and Nozzles h) Spray Headers i) Spray Nozzles j) Oxidation Nozzles k) Oxidation headers l) Internal Supporting members of absorber, spray piping, mist eliminators etc. xxix) Type of lining for absorber and ducts (Lining / Cladding / Wallpaper) xxx) Design pressure (mmwc) xxxi) Design temperature (deg C)			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 13 OF 50

CLAUSE NO.	BIDDER'S NAME		
	xxxii) Max. temperature with stand capacity and duration (oC) xxxiii) Number of inspection doors xxxiv) Dimensions of access openings of inspection doors (mm x mm) xxxv) Emergency Storage tank Capacity (hrs. of operation) xxxvi) Spray Nozzle a) Make / Model b) Type c) Spray cone angle xxxvii) Oxidation Nozzles a) Make / Model b) Type xxviii) Spray Header Diameter (mm) xxix) Oxidation Header Diameter (mm) xxx) Distance between two consecutive spray levels (mm) 2.04.00 Gas-Gas heater 2.04.01 Regenerative Gas Gas heater i) Manufacturer ii) Type iii) No. of GGH per boiler iv) Mounting v) Flue gas temperature at GGH Cold Gas Outlet (oC) (Corrected) (TMCR/50% TMCR)		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3 PAGE 14 OF 50

CLAUSE NO.	BIDDER'S NAME			
	vi)	Acid dew point for Dirty Gas and Clean Gas (Furnish curves)		
	vii)	Material Specification and thickness (mm)		
	a)	Cold end elements		
	b)	Intermediate elements		
	c)	Upper hot element		
	d)	Shaft		
	e)	Seals		
	f)	Sector Plate		
	g)	Casing		
	h)	Rotor		
			No. of Baskets	Height of elements (mm)
				Description
				Thickness (mm)
	viii)	Elements thickness/height (mm/mm) details for GGH		
	a)	Cold end elements		
	b)	Intermediate elements		
	c)	Upper hot element		
	ix)	Areas of elements		
	a)	Hot end (M2)		
	b)	Intermediate (M2)		
	c)	Cold end (M2)		
	x)	Total effective heating surface (m2)		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		PAGE 15 OF 50

CLAUSE NO.	BIDDER'S NAME
	Design Coal Worst Coal xi) Pressure drop at 100% BMCR (mmwc) a) Hot Gas Side b) Cold Gas Side xii) Type of radial seals a) Hot end b) Cold end xiii) Type of circumferential seals xiv) Type of axial seals xv) Net free area for a) Hot Gas flow (M2) b) Cold Gas flow (M2) xvi) Electric motor drive c) Motor speed (rpm) d) Motor nameplate rating (kW) xvii) Speed reducer a) Type b) Speed ratio c) Shaft power (kW) d) Manufacturer xviii) Emergency drive a) Type b) Shaft power (kw)
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 16 OF 50

CLAUSE NO.	BIDDER'S NAME
	c) Speed (rpm) d) Pressure (kg/cm²) (abs) and flow requirement of air (m³/sec) xix) Bearings a) Manufacturer b) Type c) Type of lubrication d) Lube oil circulation ratio xx) Bearing Cooling Water requirement (m³/hr) a) Quantity (M³/hr) b) Inlet pressure (Kg/cm²) c) Pressure drop (kg/cm²) d) Temperature rise (deg. C) xx) Construction features a) Seal plate adjustment external (Yes/No) b) Automatic Seal Plate Adjustment (Yes/No) c) Coupling : Flexible (Yes/No) d) Lubrication :Forced (Yes/No) e) Rotor guide bearing :Hot end (Yes/No) f) Drive : Motor/Manual (Yes/No) xxi) Accessories provided a) Lube oil pumps (Yes/No) b) Oil coolers (Yes/No) c) Oil filters (Yes/No)
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 17 OF 50

CLAUSE NO.	BIDDER'S NAME		
	d)Oil tanks(Yes/No) e)Oil pumps(Yes/No) f)Support legs & foundation bolts(Yes/No) g)Coupling guards(Yes/No) h)Solenoid valve (air motor)(Yes/No) i)Air pressure adjusting device(Yes/No) j)Relief valve(Yes/No) k)Pressure gauges(Yes/No) l)Temperature gauges(Yes/No) m)Differential pressure gauges(Yes/No) n)Sight flow fittings(Yes/No) o)Main drive motor(Yes/No) p)Air motor(Yes/No) q)Valves (Yes/No) r)Barring device(Yes/No) s)Recommended maintenance tools(Yes/No) xxii)Seal Air Fans (if provided) a)Make/Model b)Rated Flow (mmwc) c)Rated Head (mmwc) d)Rated Power (KW) e)Motor Rating (MW) xxiii)GGH Leakage with Seal Air Fans in service (%) xxiv)GGH leakage without seal air fan in service (%)		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3 PAGE 18 OF 50

CLAUSE NO.	BIDDER'S NAME			
2.04.02	xxv) Reference drawing Nos.			
	Heat Pipe Type GGH (as applicable)			
	i) No. of GGH			
	ii) Type			
	iii) Make/Model			
	iv) Manufacture			
	v) Mounting			
	vi) Heat Carrying Fluid			
	vii) Tube Pressure (kgf/cm2)			
	viii) Tube Circulation Ratio			
	ix) Circulation Type (Neutral/Pumped)			
	x) Heat Transfer Area			
	a) Hot Gas Side (m2)			
	b) Cold Gas Side (m2)			
	xi)	Fin Details	Hot Gas	Cold Gas
	a)	Type		
	b)	Pitch (mm)		
	c)	Height (mm)		
	d)	Material		
	e)	Thickness (mm)		
	xii)	Tube Side Details		
	a)	Tube Material		
b)	Thickness (mm)			
c)	Arrangement (In line/staggered)			
d)	Pitch (Transverse/Axial)			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	
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CLAUSE NO.	BIDDER'S NAME		
	e)Length (mm) f)Number xiii)Dimensions (m x m x m) (W x D x H) xiv)Net Free Area (m2) xv)Flue Gas Temperature at GGH Cold Gas Outlet (oC) xvi)Heat Transfer Coefficient (W/m2 - oC) xvii)Acid Dew Point for Dirty Gas & Clean Gas (Furnish Curves) (oC) xviii)Casing Material / Thickness (mm) xix)Circulation Pump (if applicable) a)Number b)Number Working c)Type d)Make / Model e)Rated Flow (m3/hr.) f)Rated Head (mWCi) g)Rated Power(KW) h)Design Pressure (kgf/m2) i)Design Temperature (oC) j)Pump Speed (rpm) k)NPSH available / required (mWCi) l)Power Consumption at Design Point/Guarantee Point (KW) m)Motor Rating (KW) n)Type of Casing		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 20 OF 50

CLAUSE NO.	BIDDER'S NAME
2.04.03	o) Casing Material p) Shaft Material q) Impeller Material r) Cooling Water Flow (m3/hr.) xx) Make-up Source xxi) Make-up Consumption (m3/hr.) xxii) On-load Cleaning Device - xxiii) Off-load Cleaning Device xxiv) Reference Drg. No. GGH Cleaning i) On load cleaning a) Type of blower b) (Single/multiple c) nozzle) d) Type of drive (sweep action/ retractable) e) Pressure of steam jet (Kg/cm2) (abs) f) No. of blowers g) Blower head material h) Blowing Medium i) Blowing pressure j) (Kg/cm2) (abs) k) Location

CLAUSE NO.	BIDDER'S NAME
	Water jet/Air Jet ii) Off load cleaning a) Provision made for b) off load cleaning c) Type of drive d) Medium used (water/air) e) Pressure of water/air f) required (kg/cm2)(abs) g) Quantity of water/air h) required (m3/hr) iii) Material of construction for the cleaning device a) Links b) Seal plates c) Soot blower lance d) Water jet wash head e) Worm gear f) Swivel joint g) Nozzles (steam/water) h) Air motor impeller i) Air motor casing j) Air motor shaft k) Coupling iv) Pump (if provided) a) Make / Model b) Flow (m3/hr.) c) Pressure (kgf/cm2)

CLAUSE NO.	BIDDER'S NAME			
2.05.00	Slurry Recirculation Pumps (To be indicated for each level)			
	i)	No. of pumps		
	ii)	No. of stand-by pumps		
	iii)	Manufacturer		
	iv)	Model		
	v)	Type		
	vi)	Rated Capacity		
		a)	Flow (m3/hr.)	
		b)	Head (mWCI)	
		c)	Power (KW)	
		d)	Efficiency (%)	
		e)	Slurry Concentration (% w/w)	
	vii)	Max. Slurry Concentration (% w/w)		
	viii)	Margin		
		a)	Flow (%)	
		b)	Head (%)	
	ix)	Motor Rating (KW)		
	x)	Motor Details (volts/H2)		
	xi)	Speed (rpm)		
	xii)	Synchronous Motor speed (rpm)		
	xiii)	Critical Speeds (rpm)		
	xiv)	Impeller		
		a)	Impeller type	
		b)	Impeller Diameters (mm)	
		c)	Shaft Material/Diameter (mm)	
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 23 OF 50

CLAUSE NO.	BIDDER'S NAME
2.06.00	d) Material / Thickness of Impeller (mm) e) Lining Material / Thickness (mm) xv) Casing Type xvi) Casing Material/Thickness (mm) xvii) Casing Liner Materials/ Thickness (mm) - xviii) Life of Impeller/Casing Liners (hrs.) xix) Weight of Rotating Parts (kg) xx) Weight of Static Parts (kg) xxi) Type of Seal xxii) Seal Water Flow (m3/hr) - xxiii) Cooling Water Flow (m3/hr) xxiv) Bearings a) Number b) Type xxv) Type of Coupling xxvi) Reference Drg. Nos. Absorber Tank Agitators a) No. of Agitators in each absorber b) No. of redundant agitators in each absorber c) Make / Model d) Type
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
TECHNICAL DATA SHEET SECTION-VI PART - F	
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CLAUSE NO.	BIDDER'S NAME
2.07.00	e) Speed (rpm) f) Drive Mechanism g) Shaft Material h) Material/Thickness of Impeller / Lining (mm) i) Power Consumption (KW) j) Motor Rating (rpm) k) Motor Speed (rpm) Oxidation Air Compressors i) No. of compressors ii) No. of stand-by compressors iii) Manufacturer iv) Model v) Type vi) Rated Capacity a) Flow (m3/hr) b) Head / Discharge Pressure (mmWCI/kgf/m2) c) Power (KW) d) Efficiency (%) vii) Margin a) Flow (%) b) Head (%) viii) Design Ambient Conditions (Temperature / Relative Humidity) (oC / %) ix) Motor Rating (KW)
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 25 OF 50

CLAUSE NO.	BIDDER'S NAME
	x) Motor Details (Volts/H2) xi) Speed (rpm) xii) Synchronous Motor speed (rpm) xiii) Critical Speeds (rpm) xiv) Impeller a) Impeller type b) Diameter (mm) c) Shaft Material /Diameter (mm) d) Material / Thickness of Impeller (mm) xv) Casing Type xvi) Casing Material / Thickness (mm) xvii) Casing Liner Materials / Thickness (mm) - xviii) Weight of Rotating Parts (kgs.) xix) Weight of Static Parts (kgs.) xx) Type of Seal xxi) Cooling Water Flow Requirement (m3/hr) xxii) Bearings a) Number b) Type c) Lubrication - xxiii) Type of Coupling xxiv) Reference Drg. Nos.
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
TECHNICAL DATA SHEET SECTION-VI PART - F	
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CLAUSE NO.	BIDDER'S NAME		
2.08.00	Slurry Pumps i) No. of pumps for each unit ii) No. of stand-by pumps for each unit iii) Manufacturer iv) Model v) Type vi) Rated Capacity a) Flow (m ³ /hr) b) Head (mWC) c) Power (KW) d) Efficiency(%) e) Slurry Concentration (% w/w) vii) Max. Slurry Concentration (% w/w) viii) Margin a) Flow (%) b) Head (%) ix) Motor Rating KW x) Motor Details (volts/H ²) xi) Speed (rpm) xii) Synchronous Motor speed (rpm) xiii) Critical Speeds (rpm) xiv) Impeller a) Impeller type b) Diameters (mm)	Limestone Slurry Pump	Gypsum Bleed Pump
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3 PAGE 27 OF 50

CLAUSE NO.	BIDDER'S NAME			
	c) Shaft Material /Diameter (mm) d) Material/Thickness of Impeller (mm) e) Lining Material/Thickness (mm) xv) Casing Type xvi) Casing Material/Thickness (mm) xvii) Casing Liner Materials/Thickness (mm) xviii) Life of Impeller/Casing Liners (hrs.) xix) Weight of Rotating Parts (kgs.) xx) Weight of Static Parts (kgs.) xxi) Type of Seal xxii) Seal Water Flow (m3/hr) xxiii) Cooling Water Flow (m3/hr) xxiv) Bearings a) Number b) Type xxv) Type of Coupling xxvi) Reference Drg. Nos.			
2.09.00	Limestone Grinding and Slurry Preparation system	(To be filled for Base Offer and Alternate Offer Separately)		
2.09.01	Bunker shut off gates			
	i) Manufacturer	.....		
	ii) Type	.....		
	iii) Material of the gates	.....		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 28 OF 50

CLAUSE NO.	BIDDER'S NAME			
2.09.02	iv) Motor rating (KW)	.....		
	Down spout			
	i) Manufacturer	.....		
	ii) inside diameter (mm)	.....		
	iii) Thickness (mm)	.....		
	iv) Height (mm)	.....		
	v) Material	.....		
	vi) Off set between feeder outlet and centre line of Limestone bunker, if any	.....		
2.09.03	Raw Limestone feeders			
	i) Manufacturer	.....		
	ii) Type	.....		
	iii) Feeder size	.....		
	iv) Normal capacity (tonnes/hr)	.....		
	v) Maximum capacity (tonnes/hr)	.....		
	vi) Method of output control	.....		
	vii) Speed pulser allowable VA burden	.....		
	viii) Feeder belt width (mm)	.....		
	ix) Auxiliary power consumption (KW)	.....		
	At 100% BMCR (DC / WC)			
	At 100% TMCR (DC / WC)			
	At 100% BMCR (Best Coal in Range)			
	x) Type of Drive	.....		
2.09.04	Raw coal weighers			
	i) Manufacturer	.....		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 29 OF 50

CLAUSE NO.	BIDDER'S NAME			
2.09.05	ii)	Model Number	.....	
	iii)	Method of measurement	.....	
	iv)	Range of measurement (kg/hr)	.....	
	Downspout from feeder outlet to pulverizer			
	i)	Manufacturer	.....	
	ii)	inside diameter (mm)	.....	
	iii)	Thickness (mm)	.....	
	iv)	Material	.....	
	v)	Height (mm)	.....	
	vi)	Off set between feeder outlet and centre line of limestone bunker, if any (m)	.....	
2.09.06	Limestone Pulverizers			
	A.	Design Data :		
	i)	Manufacturer		
	ii)	Type and model		
	iii)	Total Number of mills		
	iv)	Mill maximum capacity (kg/hr)		
	v)	Size of raw limestone at mill inlet (mm)		
	vi)	Bond Index of Limestone		
	vii)	Fineness of pulverized coal through 325 mesh (%)		
	viii)	Pulverizer Speed (rpm)		
	ix)	Total Limestone consumption (kg/hr) with all units working at		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 30 OF 50

CLAUSE NO.	BIDDER'S NAME			
	x) 100% BMCR (DC/WC/Best of Range) xi) 100% TMCR (DC/WC/Best of Range) Number of mills working with all units working at 100% BMCR (DC/WC/Best of Range) 100% TMCR (DC/WC/Best of Range) xii) Mill loading of working mills (% of maximum capacity) when no of mills as per (I) are operating xiii) Mill Power Consumption xiv) Mill Main Motor Rating (KW) xv) Main Motor (Voltage/H2/rpm) xvi) Overall dimensions xvii) Total weight including motor xviii) Solid Concentration (w/w %) in mill xix) Method of Classification xx) Ball Consumption (kg per ton of limestone) B. Constructional Features i) Material / Thickness of Mill Wear Liners ii) Guaranteed Wear Life of Wear Liners iii) Estimated labour (in man hours) for replacement of wear liners)			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 31 OF 50

CLAUSE NO.	BIDDER'S NAME		
	iv)Material / Diameter (mm) of Ball C. Type of drive transmission a)Make / Model of Gearbox b)Speed Ratio D. Type of coupling E. Pulverizer lube oil system a)No. of lube oil pumps per pulverizer b)No. of lube oil pumps working c)No. of oil coolers per pulverizer d)No. of oil coolers per working F. Auxiliary Motor Rating (KW) G. Mill speed with Auxiliary Motor (rpm) H. Mill Separator Tank i)Capacity (m3) ii)Material/Thickness (mm) iii)Lining Material/Thickness (mm) iv)No. of Agitators I. Mill circuit Pump i)No. per mill ii)No. of stand-by pumps iii)Make/Model iv)Impeller Type v)Material/Thickness (mm) of Impeller and lining		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3
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CLAUSE NO.	BIDDER'S NAME			
	vi) Casing Type vii) Material/Thickness (mm) of Casing/Lining viii) Rated Flow Head (m3/hr / mWCI) ix) Slurry Solid concentration (w/w %) J. Agitators i) No./Make/Model ii) Type iii) Speed (rpm) iv) Drive Mechanism v) Shaft Material vi) Material / Thickness (mm) of Impeller / Lining vii) Power Consumption viii) Motor Rating (KW) ix) Motor Speed (rpm) K. Hydro-cyclone i) Make / Model ii) Number working iii) Flow Capacity (m3/hr) iv) Inlet Solid Concentration (% w/w) v) No. of Hydro-cyclone in each set vi) No. of spare hydro-cyclone in each set			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 33 OF 50

CLAUSE NO.	BIDDER'S NAME
2.10.00	vii) Under flow Volume (m3/hr) Solid Concentration (% w/w) viii) Overflow Volume (m3/hr) Solid Concentration (% w/w) ix) Size / Material / Thickness (mm) of base / Lining a) Feed Chamber b) Apex Stopper c) Cone Casing d) Under flow pipe e) Overflow pipe x) Pressure Drop at rated capacity (mmWC) xi) Design Pressure Limestone Slurry Preparation Tank i) No. of Tank ii) Capacity (m3) iii) Slurry Solid concentration (w/w%) iv) Tank Capacity at 100% BMCR (DC/WC/Best of range) (hrs.) v) Dimensions (WxDXH) vi) Material / Thickness (mm) vii) Lining Material / Thickness (mm) viii) No. of Agitators
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F
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CLAUSE NO.	BIDDER'SNAME				
2.10.01	ix) No. of Redundant Agitators				
	Limestone Slurry Tank Agitators				
	i) No. of Agitators in each Tank				
	ii) No. of redundant agitators in each tank				
	iii) Make / Model				
	iv) Type				
	v) Speed (rpm)				
	vi) Drive Mechanism				
	vii) Shaft Material				
	viii) Material / Thickness (mm) of Impeller / Lining				
	ix) Power Consumption (KW)				
	x) Motor Rating (rpm)				
	xi) Motor Speed				
	2.11.00	Gypsum Dewatering System			
i) No. of Streams					
ii) No. of Streams Stand-by					
iii) Primary Hydro-cyclone					
a) Make / Model					
b) Number working					
c) Flow Capacity (m3/hr)					
d) Inlet Solid Concentration (% w/w)					
e) No. of Hydro-cyclone in each set					
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		SUB-SECTION:DM3	PAGE 35 OF 50

CLAUSE NO.	BIDDER'S NAME
	f) No. of spare hydro-cyclone in each set g) Under flow Volume (m3/hr) Solid Concentration (% w/w) h) Overflow Volume (m3/hr) Solid Concentration (% w/w) i) Size (mm) / Material / Thickness (mm) Feed Chamber Apex Stopper Cone Casing Under flow pipe Overflow pipe j) Pressure Drop at rated capacity (mmWC) k) Design Pressure (kgf/cm2) iv) Vacuum Belt Filters a) Manufacturer b) Model c) Dimensions (W x L x H) (m x m x m) d) Cloth Width (m) e) Cloth Length (m) f) No. Working / Stand-by
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
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CLAUSE NO.	BIDDER'S NAME
	g) Capacity (Guaranteed) Gypsum (Dry) (kg/hr) Gypsum (Slurry) (m3/hr) h) Inlet Flow Volume (m3/hr) Solid Concentration (% w/w) i) Gypsum Flow (Dry) kg/hr j) Moisture Removed (%) k) No. of stages of cake washing / water flow (m3/hr) l) No. of stages of cloth washing / water flow (m3/hr) m) Design Pressure of Vacuum Chamber (kgf/cm2/a) n) Operating Pressure of Vacuum Chamber (kgf/cm2/a) o) Material / Thickness (mm) Casing Cloth Gypsum Discharge Hopper Vacuum Box p) Life of Cloth (hrs.) q) Type /Material of Carrying Belt r) Type / Material of Sealing Belt s) Life of Carrying Belt (hrs.) t) Life of Sealing Belt (hrs.) u) Automatic Cloth Tensioning Mechanism Provided YES/NO
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
TECHNICAL DATA SHEET SECTION-VI PART - F	
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CLAUSE NO.	BIDDER'S NAME
	v) Vacuum Receiver Tank a) No. of Tank b) Capacity (m3) c) Dimensions (Dia x Height) (mm x mm) d) Material / Thickness (mm) e) Lining Material / Thickness (mm) vi) Vacuum Pumps a) Make / Model b) Type c) No. of Pumps for each Vacuum Belt Filter d) Rated Capacity Flow/ Head/ Power (m3/hr/mWC/KW) e) Power Consumption (KW) f) Pump Speed (rpm) g) Motor Rating (KW) h) Motor Speed (rpm) i) Margins (Flow / Head) (% / %) j) Operating Pressure (kgf/cm2/a) k) Design Pressure (kgf/cm2/a) l) Material / Thickness (mm) of Base/Lining Casing Shaft Impeller
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 38 OF 50

CLAUSE NO.	BIDDER'S NAME			
2.12.00	m) Type of Seal n) Sealing Water Flow (m3/hrs) o) Bearing - No. of Bearings - Type of Bearings p) Type of coupling q) Whether Silencer Provided at Outlet YES/NO vii) Filtrate Tank a) No. of Tank b) Capacity (m3) c) Dimensions (WxDXH) d) Material / Thickness (mm) e) Lining Material/Thickness			
	Slurry Pipes	Recirculation Slurry	Limestone Slurry	Gypsum Slurry
	i. Pipe size (mm)			
	ii. Type of Joints a) Pipe to Pipe/Pipe to Fittings b) Fittings			
	iii. Material / Thickness (mm) of Pipe			
	iv. Material Thickness of lining			
	v. Estimated Life of liners (hrs.)			
	vi. Slurry Solid concentration (w/w %)			
	vii. Slurry Settling Velocity (m/s)			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 39 OF 50

CLAUSE NO.	BIDDER'S NAME
2.13.00 2.13.01 2.13.02	viii. Pipe Velocity (m/s) Secondary Waste Water Hydro-cyclone Feed Tank a) No. of Tank b) Capacity (m3) c) Dimensions (WxDXH) (m x m x m) d) Material / Thickness (mm) e) Lining Material / Thickness (mm) Secondary Waste Water Hydro-cyclone Feed Pump a) No. b) No. of stand-by pumps c) Make / Model d) Impeller Type e) Material / Thickness (mm) of Impeller and lining f) Casing Type g) Material/Thickness of Casing/Lining h) Rated Flow/Head (m3/hr./mWCI) i) Slurry Solid concentration (w/w %) Secondary Waste Water Hydro-cyclone a) Make / Model b) Number (working + standby) c) Flow Capacity (m3/hr.) d) Inlet Solid Concentration (% w/w) e) No. of Hydro-cyclone in each set
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 40 OF 50

CLAUSE NO.	BIDDER'S NAME			
2.14.00	f)	No. of spare hydro-cyclone in each set		
	g)	Under flow Volume (m3/hr.) Solid Concentration (% w/w)		
	h)	Overflow Volume (m3/hr.) Solid Concentration(% w/w)		
	i)	Size (mm)/ Material / Thickness (mm) of base / Lining		
	a)	Feed Chamber		
	b)	Apex Stopper		
	c)	Cone Casing		
	d)	Under flow pipe		
	e)	Overflow pipe		
	j)	Pressure Drop at rated capacity (mmwc)		
	k)	Design Pressure (kgf/cm2)		
	Waste Water Tank			
	i)	No. of Tank		
	ii)	Capacity (m3)		
	iii)	Dimensions (WxDXH) (m x m x m)		
	iv)	Material / Thickness (mm)		
	v)	Lining Material / Thickness (mm)		
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		PAGE 41 OF 50

CLAUSE NO.	BIDDER'S NAME
2.14.01	Waste Water Pump i) No. ii) No. of stand-by pumps iii) Make / Model iv) Impeller Type v) Material / Thickness (mm) of Impeller and lining vi) Casing Type vii) Material / Thickness (mm) of Casing / Lining viii) Rated Flow Head (m³/hrs/mWCI) ix) Slurry Solid concentration (w/w %)
2.15.00	Sump Pump (for absorber area, limestone grinding area and gypsum dewatering area sumps) i) No. ii) No. of stand-by pumps iii) Make / Model iv) Impeller Type v) Material / Thickness (mmWCI) of Impeller and lining vi) Casing Type vii) Material/Thickness of Casing/ Lining viii) Rated/Flow Head ix) Slurry Solid concentration (w/w %)
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
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CLAUSE NO.	BIDDER'S NAME			
2.16.00	Absorbent Auxiliary Slurry Sump i) Capacity (m3) Recommended ii) Slurry Solid concentration (w/w %) iii) No. of Agitators iv) No. of Redundant Agitators			
2.17.00	Absorbent Auxiliary Slurry Sump Agitators i) No. of Agitators in Sump ii) No. of redundant agitators iii) Make / Model iv) Type v) Speed (rpm) vi) Drive Mechanism vii) Shaft Material viii) Material / Thickness (mm) of Impeller / Lining ix) Power Consumption x) Motor Rating (KW) xi) Motor Speed (rpm)			
2.18.00	Absorbent Auxiliary Slurry Sump Pumps i) No. of pumps ii) No. of stand-by pumps iii) Manufacturer iv) Model v) Type			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3	PAGE 43 OF 50

CLAUSE NO.	BIDDER'S NAME			
	vi) Rated Capacity a) Flow (m3/hr) b) Head (mWCI) c) Power (KW) d) Efficiency (%) e) Slurry Concentration (% w/w) vii) Max. Slurry Concentration (% w/w) viii) Margin a) Flow (%) b) Head (%) ix) Motor Rating (KW) x) Motor Details (volts/Hz) xi) Speed (rpm) xii) Synchronous Motor speed (rpm) xiii) Critical Speeds (rpm) xiv) Impeller a) Impeller type b) Diameters (mm) c) Shaft Material /Diameter (mm) d) Material / Thickness (mm) of Impeller e) Lining Material / Thickness (mm) xv) Casing Type			
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		SUB-SECTION:DM3
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CLAUSE NO.	BIDDER'S NAME
2.19.00	xvi) Casing Material / Thickness (mm) xvii) Casing Liner Materials / Thickness (mm) - xviii) Life of Impeller / Casing Liners (hrs.) xix) Weight of Rotating Parts (kgs.) xx) Weight of Static Parts (kgs.) xxi) Type of Seal xxii) Seal Water Flow (m3/hr) - xxiii) Cooling Water Flow (m3/hr) xxiv) Bearings a) Number b) Type xxv) Type of Coupling xxvi) Reference Drg. Nos. INSULATION AND CLADDING i) Area to be insulated per unit (m2) a) GGH Hot Gas Inlet Duct b) Absorber Inlet Duct c) Absorber d) Absorber Outlet duct e) GGH Cold Gas Inlet Duct f) Absorber Bypass Duct g) Stack Inlet Duct h) Total
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
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CLAUSE NO.	BIDDER'S NAME		
3.00.00	ii)	Material	
	iii)	Insulating material standard	
	iv)	Thickness (mm)	.....
	v)	Density (Kg/M3)	.....
	vi)	Thermal conductivity (Kcal/m/hr/deg.C) at mean temperature of	
	a)	50 deg. C	
	b)	100 deg. C	
	c)	150 deg. C	
	d)	200 deg. C	
	vii)	Resistive to micro organism	(Yes/No)
	viii)	Incombustibility (Yes/No)	.....
	ix)	Material of skin casing	.....
	x)	Thickness of skin casing	.....
	EQUIPMENT WEIGHT (TOTAL) (in tons)		
	i)	FGD System	.....
	a)	Structural Steel	.....
	b)	Absorber and Oxidation Tank casing	.....
	c)	Slurry Spray Nozzles and Headers	.....
	d)	Oxidation air nozzles and Headers	.....
	e)	Mist Eliminators	.....
	ii)	Ducts & Gates	.....
	iii)	Recirculation Slurry Pumps and piping	.....
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F	SUB-SECTION:DM3
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CLAUSE NO.	BIDDER'S NAME
	iv) Oxidation Compressors and piping v) Gypsum Bleed pump and piping vi) Limestone Slurry Pumps and piping vii) Limestone Grinding System a) Feeders b) Mills c) Hydro-cyclones and pumps d) Tanks e) Structural Steels viii) Slurry Tank Agitators ix) Gypsum Dewatering System a) Hydro-cyclones b) Vacuum Belt Filters c) Vacuum Receivers & Pumps d) tructural Steel x) Slurry Pipes & Valves xi) Galleries, stair ways and walkways xii) Thermal insulation and Cladding xiii) Control and Instrumentation xiv) Others xv) Total estimated weight
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	
TECHNICAL DATA SHEET SECTION-VI PART - F	
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CLAUSE NO.	BIDDER'S NAME				
4.00.00	DATA FOR REFERENCE PLANTS (USE ONE SEPARATE SHEET FOR EACH REFERENCE PLANT)				
4.01.00	Power Plant details i) Unit rating (MW) ii) Commissioning Date				
4.01.01	Absorber Design i) Design flue gas flow (m3/sec) ii) Design flue gas temperature (deg C) iii) No. of Absorbers per boiler iv) No. of spray levels (working + stand-by) in each absorber v) L/G Ratio at Design Point vi) Gas velocity at design flow (m/s) vii) Minimum redundancy in slurry recirculation pumps viii) Height of Absorber (m) ix) Guaranteed power consumption (KW) x) Max. Inlet Dust Burden (mg/Nm3) xi) Guaranteed Outlet Dust burden (mg/Nm3)				
4.01.02	Design fuel i) Fuel Type ii) Ash Content (%) iii) Moisture Content (%)				
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL DATA SHEET SECTION-VI PART - F		SUB-SECTION:DM3	PAGE 48 OF 50

CLAUSE NO.	BIDDER'S NAME
4.01.03	iv) Gross Calorific value (Kcal Kg) v) Sulphur content (%) in coal SO2 Removal Efficiency i) Guaranteed efficiency (%) ii) Acceptance test efficiency (%)
4.02.00	Availability Data
5.00.00	PROPOSED SUB-CONTRACTORS i) FGD System ii) Structural Steel iii) Absorber and Oxidation Tank casing iv) Slurry Spray Nozzles v) Oxidation air nozzles vi) Mist Eliminators vii) Ducts viii) Gates ix) Recirculation Slurry Pumps x) Oxidation Compressors xi) Gypsum Bleed and Limestone Slurry Pumps xii) Limestone Grinding System a) Feeders b) Mills c) Hydro-cyclones d) Tanks
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 49 OF 50	

CLAUSE NO.	BIDDER'S NAME
	xiii) Slurry Tank Agitators xiv) Gypsum Dewatering System a) Hydro-cyclones b) Vacuum Belt Filters c) Vacuum Receivers d) Vacuum Pumps xv) Slurry Pipes xvi) Slurry Valves xvii) Galleries ad stair ways xviii) Internal walk ways xix) Thermal insulation xx) Cladding xxi) Instruments
BONGAIGAON THERMAL POWER PROJECT (3 x 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL DATA SHEET SECTION-VI PART - F SUB-SECTION:DM3 PAGE 50 OF 50

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
SCOPE OF SUPPLY				
1.00.00	The contractor's scope of supply shall include engineering, design, supply, erection, commissioning and testing of complete mechanical, electrical, C&I and associated civil and structural works for Flue Gas Desulphurization system and its auxiliaries for three (3) number steam generators of 250 MW nominal rating, as detailed in this specification. The FGD system shall be necessarily based on Wet Lime Stone FGD technology and is intended to reduce the emissions of Sulphur Dioxide in flue gas produced by coal being fired in boiler to the limits specified elsewhere in the technical specification.			
1.01.00	Complete Control & Instrumentation system as required for the FGD system shall be included in the scope of supply. All electrical drives and actuators required for the equipments/valves/dampers shall be in the contractor's scope. Civil works (excluding foundation) such as grouting required for mills/pumps and any other equipments etc. is included in the contractor's scope of work. The contractor shall also include all supporting and structural works, like pipe trestles in their scope of work.			
1.02.00	The scope of supply identified for FGD system here are minimum requirements and unless specifically excluded from the contractor's scope in sub-section-V (Terminal Points and Exclusions), any equipment/system not included in this specification but integral to the system offered by the contractor to meet the intent of this specification, shall also be included in the scope of the contractor.			
1.03.00	The FGD system shall have an independent absorber for each unit, common limestone milling systems for the three units and common gypsum dewatering system for the three units. The contractor shall also supply an auxiliary absorbent tank, common for the three units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers, limestone grinding system and gypsum dewatering system.			
1.04.00	The scope of the contractor for FGD system shall include all items as shown in Tender drawings 4610-102-POM-A-006 (3 sheets). All ducting, dampers, pumps, valves, supports, etc. as required for completeness of system of absorbers, common limestone grinding system and common gypsum dewatering system shall also be in the scope of the contractor.			
2.00.00	SYSTEM DESCRIPTION			
2.01.00	The FGD system shall be based on Wet Limestone Forced Oxidation process. Each unit shall be provided with an independent absorber.			
2.02.00	Gas from ID fan discharge shall be taken to the absorber through a Gas-Gas Heater. In the absorber, SO ₂ in flue gas shall be removed by a spray of recirculating slurry, pumped by slurry recirculation pumps. Alternatively, the gas shall be bubbled through the absorber slurry to remove the SO ₂ from flue gas. Only proven system supplied earlier by the FGD vendor shall be supplied by the contractor.			
2.03.00	Compressed oxidation air shall be blown through the slurry in the oxidation tank, to oxidize the Calcium sulfite to gypsum. The oxidation system may be either grid sparge type or lance jet type as per the proven practice of the FGD vendor.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-A-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 1 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
2.04.00	Clean gas from the absorber shall be taken to the GGH through two stage mist eliminators. Treated and reheated flue gas from the absorber shall be discharged through a 220 m high stack (being procured by the employer under a separate contract). The contractor shall terminate the flue gas duct at an elevation of 31 m above the finished floor level inside the chimney for interconnection with flue provided in the chimney. Provision shall be made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation.			
2.05.00	Limestone to the absorbers of the three (3 no) units shall be supplied by a wet limestone grinding, common for the three units. Each wet limestone mill shall be fed from an independent bunker (being procured by the employer under a separate contract) through a gravimetric feeder. The classified limestone slurry from the mills shall be stored in two (2 no) limestone slurry storage tank, from where the slurry shall be pumped to the individual absorbers by dedicated limestone slurry pumps.			
2.06.00	The gypsum from the three (3 no) absorbers shall be pumped by dedicated gypsum bleed pumps to a common Gypsum Dewatering system consisting of multiple streams of primary and secondary dewatering equipments. The water removed from the absorber shall be recycled to the absorbers. The waste water from the system shall be collected and neutralized using lime and neutralized effluent shall be pumped to Employer's Ash slurry sump by Contractor. Washed and dewatered gypsum fro the dewatering system shall be fed to a belt conveyor. The contractor shall discharge the gypsum cake above the belt conveyor (being procured by the employer under a separate contract).			
2.07.00	A common auxiliary absorbent tank shall be provided for storage of absorber slurry of one absorber along with slurry pumps for pumping the slurry back to any of the absorber.			
3.00.00	LIMESTONE GRINDING SYSTEM (COMMON FOR THREE (3) UNITS)			
3.01.00	The contractors scope shall include a common limestone grinding system for the three units and shall comprise of :			
3.01.01	5 no. wet tube mills along with all accessories.			
3.01.02	In addition to the base offer as described above, the bidder, as an alternate offer, may also provide a system comprising of 2x100% tube mills with each mill sized to meet 110% of the maximum limestone requirement of all the three units operating simultaneously at 100% BMCR, with Design/Worst/Best Coal (whichever gives the maximum limestone requirement). The bidder shall furnish complete details covering technical features, impact on guarantee parameters, cost implication etc. for the employer to assess the alternate offer in totality. Bidder shall furnish guarantee schedules for the alternate offer separately as per format enclosed in BPS.			
3.01.03	2 limestone slurry tanks, each with 2 hrs storage capacity for 3 units.			
3.01.04	2x100% limestone slurry pumps for each unit (total 6 nos.)			
3.01.05	Limestone slurry piping to each absorber, along with recirculation lines (if required), all isolation and control valves.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
3.01.06	Each mill shall be fed from an independent Limestone bunker provided by the employer under a separate contract. Each mill shall be complete with the following items, as a minimum requirement: i. A bunker outlet gate ii. A gravimetric limestone feeder along with its drive and all other auxiliaries iii. 1 no. separator tank with agitator(s). iv. 2x100% Mill circuit pump. v. 1 set of hydro-cyclone vi. A peripheral drive system with motor, speed reducer gearbox and other auxiliaries. vii. An auxiliary motor for inching operation with speed reducer. viii. Complete lubricating system with 1 no. lube oil tank. ix. Lube oil pumps, coolers, duplex oil filters, connecting piping and necessary load & remote indicating instruments. Each lube oil pump and cooler shall have a 100% identical stand-by. All connecting pipes / chutes along with necessary valves between various systems of the mill and from hydro-cyclone to common slurry storage tanks shall also be in the scope of the contractor. Necessary pipes, pipe supports, trestles etc. as required for the routing of the pipes shall be under the contractor's scope. Any item not included above but necessary for safe and reliable operation of the milling system proposed by the contractor shall also be in the contractors' scope.			
4.00.00	ABSORBER SYSTEM			
4.01.00	An independent Limestone Forced Oxidation (LSFO) type absorber system shall be provided for each unit. Each absorber system shall be complete with :			
4.01.01	1x100% Gas Gas heater (GGH) suitable for handling the entire flue gas generated by Boiler at 100% BMCR, using the worst coal specified.			
4.01.02	Complete Ducting System from GGH to absorber tower, from absorber tower to GGH, GGH outlet ducts absorber bypass duct and connecting duct to chimney.			
4.01.03	Motorized or pneumatic isolation gates at GGH hot gas inlet, cold gas outlet and absorber bypass duct.			
4.01.04	Absorber tower complete with re-circulating slurry spray header(s) and nozzles, 2 stage mist eliminators, wash water nozzles, oxidation tank integral to tower, oxidation headers and nozzles, and agitators and all internal systems integral to the working of the absorber.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-A-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 3 OF 6

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
4.01.05	2x100% re-circulating slurry pump for each level of spray. Alternately, the contractor may offer a spare level of spray with each spray level served by an independent 100% pump. If the contractor offers a single level of sprays there shall be atleast 3 x50% slurry recirculation pump. (In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No re circulating pump and spray header and nozzles shall be required in such case.)		
4.01.06	2x100% oxidation blowers / compressors.		
4.01.07	1 No. Emergency water tank		
4.01.08	All connecting piping and valves required by the system.		
4.01.09	2x100% gypsum bleed pumps		
4.01.10	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves.		
4.01.11	Routing of the duct/piping system complete with supports, structures, trestles as required shall be in the contractor's scope of supply.		
5.00.00	GYPSUM DEWATERING SYSTEM		
5.01.00	The employer envisages a common gypsum dewatering system for the three units. The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of 5 sets of dewatering equipments.		
5.02.00	Each set (suitable for handling /dewatering of one unit) of dewatering equipment (3 working set + 2 standby set) shall comprise of the following items as a minimum requirement: i. One set of primary hydro-cyclones ii. One vacuum belt filter iii. One no. vacuum receiver iv. One no. vacuum pump v. Complete piping and valves for the system along with wash water line.		
5.03.00	As an alternate offer, the bidder may also offer a system comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the three units operating simultaneously at 100% BMCR, with any coal from the specified range of coals (whichever gives the maximum gypsum flow). All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification. Bidder shall furnish guarantee schedules for the alternate offer separately as per format enclosed in BPS. Bidder shall indicate the applicable rebate for such an alternate offer in the relevant attachment of the schedule. The bidder		
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	shall also furnish details of the previous installations of such system and the complete technical details, effect on guarantees and the commercial implications for the Employer to assess the suitability of the alternative. Bidder shall furnish guarantee schedules for alternate offer separately as per format enclosed in BPS. The alternate offer shall also include mandatory spares for all the items and their corresponding quantities as specified in the Technical Specification.			
5.04.00	The filtrate water from belt filter dewatering and washing system and the over flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank. 2x100% pump shall be provided to supply wash water to the belt filters. In addition, 2x100% Filtrate water pump (common for all units) shall be provided to recycle the filtrate to the absorber. The contractor shall include the necessary piping and valves in their scope.			
5.05.00	The overflow from the primary set of hydro-cyclone shall be taken to a common tank. 2x100% pump shall be provided to feed 2x100% secondary hydro-cyclones.			
5.06.00	The under flow from the secondary hydro-cyclone shall be taken to the filtrate tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water tank. 2x100% waste water pumps shall be provided to discharge the waste water, after neutralization, to employer's ash water system.			
5.07.00	All the piping with supports, trestles as required as well as in the contractors' scope. The contractor shall also include any other item not included above but necessary to make the system complete.			
6.00.00	AUXILIARY ABSORBENT SUMP			
6.01.00	The employer shall provide a common auxiliary absorbent sump, common for the three units, of sufficient capacity for storage of absorber slurry of one unit.			
6.02.00	The contractor shall provide 2x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 12 hrs (max.). All agitators, piping, valves, fittings and other structures required for the system shall be included in the scope of the contractor.			
7.00.00	PROCESS WATER STORAGE & PUMPING SCHEME			
7.01.00	Two (2) numbers of Water Storage tanks			
7.02.00	3x50% Process Water Pumps to cater to process water requirement of the complete FGD system and the auxiliaries of all the units.			
7.03.00	3x50% Mist Eliminator Wash Water Pump common for all units.			
8.00.00	SUMP PUMPS			
8.01.00	The employer shall provide sumps of adequate capacity in each of the following area: A. Each Absorber Area			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
8.01.02	B. Limestone Grinding and Slurry Preparation system C. Gypsum dewatering system The contractor shall provide agitators and sump pumps of required capacity in each of this area along with necessary pipes, isolation / control valves etc for pumping back the water in the sump into the respective system.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
CONTROL AND INSTRUMENTATION SYSTEM				
1.00.00	GENERAL			
1.01.00	The Contractor shall provide Control & Instrumentation system for control, monitoring and operation of the systems, equipment etc. covered under these specifications, in all regimes of operation in safe and most efficient manner. The scope of work for the equipment, material and system to be furnished in accordance with this specification shall include design, engineering, manufacture, fabrication, assembly, pre-shipment testing at manufacturer's works, proper packing for transportation, delivery at plant site, unloading, storage, installation, interconnection with related plant and equipment, calibration, testing, commissioning and putting the Control and Instrumentation System together with all accessories, auxiliaries and associated equipment as specified hereinafter in a fully operational condition and in the manner acceptable to the Employer as covered under this specification. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. The work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract. The requirements of statutory Authorities (e.g. MOEF, Inspector of Factories, IBR, TAC, CPCB/SPCB/CERC etc with regard to various plant areas like main plant, Fuel Oil Plant/System, Chlorinating Plant, Fire fighting system, Emission measurements etc.) shall be complied even if not actually spelt out.			
1.02.00	It shall be the responsibility of the Contractor to coordinate with Employer and offer Control and Instrumentation System to meet the actual requirements of the plant and furnish a complete system as per clause 1.01.01 above, and also to coordinate with other system vendors for proper interfacing of Control and Instrumentation system vendors with all other related equipment and systems.			
1.03.00	The following clauses describe the brief scope of supplies only. The detailed technical specifications are stipulated under various Control and Instrumentation Sub-sections, Part - B, Section-VI of the specification as well as in various other Parts of the Technical Specifications.			
1.04.00	Unless explicitly stated to be common for all the unit(s), the Contractor shall provide all system/equipment described in this specification for each of the unit(s).			
2.00.00	DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)			
2.01.00	Latest state of the art microprocessor based Distributed Digital Control, Monitoring & Information System (DDCMIS) meeting the previous clause shall be provided comprising of the following as a minimum and meeting all requirements specified under Sub-section DDCMIS of Part -B, Section-VI of Technical Specification.			
2.02.00	Control system (Including its Measurement system)			
2.02.01	The control system shall broadly consist of the following system(s):-			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
2.02.02	The SG C&I system comprising of Burner Management system (BMS), Secondary Air Damper Control (SADC), Soot Blowers Controls, Aux. PRDS control, Separator Drain Control System (For Once Through Boiler), Atomizing Steam/Air Pressure Control, Fuel oil header pressure/flow control, Mill fire control, mill lube oil pump control etc. The BMS shall comply with NFPA 85. The Master Fuel Trip (MFT) Sub Group of BMS shall comply with VDE0116, VDE 0160 etc.			
2.02.03	The functional grouping of the above system(s) shall be as per Drawing No. 4610-101-POI-A-009.			
2.02.04	The above system(s) shall include their respective measurement system for signal acquisition, conditioning and signal distribution of various types of inputs/outputs, meeting specification requirements including respective Hardware requirements as stipulated in Sub-section -DDCMIS, Part-B, Section-VI of Technical Specification.			
2.03.00	Human - Machine Interface & Plant Information System (HMIPIS)			
2.03.01	HMIPIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC/TCP/IP protocols, etc. shall be provided. Any of the two options of HMIPIS as detailed out in Sub-section DDCMIS of part -B, Section-VI of Technical Specification shall be supplied. This will include the following as a minimum:			
2.03.02	Operator Work Station (OWS), mounted on Control Desk (UCD) in Central Control Room (CCR).			
2.03.03	Processing Stations (Servers/Workstations) in redundant configuration as per DDCMIS Supplier's standard practice shall be used for historical storage and retrieval and long term storage and retrieval of data.			
2.03.04	An additional OWS and one programming station per unit with state of the art computer furniture shall be provided in the Control Equipment Room.			
2.03.05	Network ready Colour laser printers for taking printout of logs/reports colour hardcopy and for plotting curves/graphs. Stations, etc.			
2.03.06	The quantity of peripherals of HMIPIS shall be as specified under Appendix-I to C& I systems, Part-B, and Section-VI of Technical Specification.			
2.04.00	Data Communication System			
2.04.01	System Bus connecting Control System and HMIPIS. Other bus systems for connecting various systems/subsystems of DDCMIS like Cubicle Bus, Local Bus, I/O Bus (Including Remote I/O Bus) soft links (including those from Field Bus based temperature transmitter) as well as within systems/sub-systems of DDCMIS. All the bus systems shall be redundant except for back plane buses which can be non-redundant.			
2.05.00	System programming, diagnostics & documentation facility.			
2.05.01	The programmer station shall be provided for configuration /tuning/structuring of control system and program development /modification of HMIPIS for each of the			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	unit(s). A Workstation based system documentation facility for automatic generation of system documentation shall be provided for each of the unit(s) to achieve paperless documentation for the project. The diagnostic system shall have elaborate diagnostics facility giving details of fault in individual channels of I/O modules, other modules and cabinets on Monitors in form of display and text messages.			
2.06.00	Power Supplies			
2.06.01	Redundant power packs/ supplies for powering the systems described above in system cabinets with necessary auctioneering and distribution.			
2.07.00	Cabinets (a.) System cabinets housing electronic modules and power pack supplies of system described above. (b.) Marshalling cabinets separate from system cabinets for terminating inputs from field, MCC/SWGR etc., for further wiring to control system and for terminating outputs from control system to MCC/SWGR etc. In case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided. (c.) Relay cabinet-housing relays for providing contact outputs by control system to other system wherever contacts are used in circuit/scheme of Control supply/power supply of more than 24 V and in cases where the VA burden is more than the VA burden the Output module can drive. Alternatively, these relays can also be mounted in termination/marshalling cabinets also. It may be noted that relays can not be mounted in system cabinets.			
2.08.00	Warranty and Annual Maintenance Contract			
2.08.01	Warranty and Annual Maintenance Contract (AMC) for DDCMIS, as per Sub-section DDCMIS, Part -B, Section-VI of Technical Specification.			
3.00.00	MAIN EQUIPMENT RELATED CONTROL & INSTRUMENTATION SYSTEM Other special C&I systems shall be provided by bidder including but not limited to the following as a minimum as per the requirement of Sub-section Main Eqpt Inst. Sys., Part -B, Section-VI of Technical Specification. Flame Monitoring System. Coal-Feeder Control & Instrumentation. Electromatic safety valves. Furnace temperature probes. Acoustic Pyrometer.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
4.00.00	Furnace and Flame Viewing System. Electronic Remote Drum Level monitoring system Mill and Air Heater Fire Detection System. MEASURING INSTRUMENTS (PRIMARY & SECONDARY) The following shall be provided as minimum meeting specification requirements of Sub-section – MEAS INST of Part-B, Section-VI of Technical Specification.			
4.01.00	Primary instruments like Microprocessor based transmitters employing HART protocol, thermocouples & RTDs, pressure/diff. Pressure/temperature/flow switches & gauges, flow sensing elements (orifice plates, flow nozzles, impact head type elements etc.) Ultrasonic, Radar type level transmitters , positive displacement type flow transmitters etc. for : (a) Main plant and auxiliary plant, as indicated in enclosed tender diagrams (P&IDs / flow schemes). (b) Integral to equipment which are not indicated in the tender drawings, but are required for control, monitoring and operation of the equipment / plant systems for which no P&IDs are enclosed, all the instruments shall be provided to meet the actual system requirements and meeting redundancy and other requirements specified under technical specifications subject to Employer's approval. (c) For Binary and analog inputs required in major equipment (eg. Furnace) protection triple-sensing devices shall be provided. Binary and analog inputs, which are, required for protection of more than one equipment as well as protection signals for HT Drives (fed by a supply feeder of ratings 3.3 kV onwards) etc., triple sensing devices shall be provided. (d) For other critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of generation, non-availability of a major equipment etc.), triple sensors shall be provided. (e) Temperature elements, electronic transmitters etc. are to be provided for all the cases. Uses of process actuated switches are acceptable only in the cases as indicated in the tender drawings.			
4.02.00	Head mounted/ Rack mounted/ Dual input Field mounted temperature transmitters for temperature elements to be used in Contractor's Control system are to be provided by the contractor as per the followings. a) Contractor shall provide at least one Dual input temperature transmitter for temperature measurements being used in trip/ protection/ major interlock of Steam generator and major auxiliaries. e.g. When three/two temperature measurement points are being used for monitoring one bearing temperature, both the elements of one duplex temperature element is to be connected to one Dual input temperature transmitter.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	b) Head mounted transmitters may be provided for temperature elements which are located in accessible areas as decided during detailed engineering. c) Remaining temperature transmitters are to be DIN rail mounted type. e) Temperature transmitter with Profi Bus / Foundation Field Bus/ any other suitable interface with SG-C&I system hardware for Boiler SH/RH metal temperature measurement applications (to be used for purely information purpose only) are also to be provided by Contractor.			
5.00.00	ELECTRIC POWER SUPPLY SYSTEM Microprocessor based modular DC power supply system shall be used for powering the control systems including its network devices. Each set of 24 V DC power supply shall consist of 2 x 100% chargers, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, DC distribution boards and other accessories as detailed out in sub-section "Power Supply". Contractor shall provide power supply distribution panels/cabinets/boxes for subdistribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry, switch fuse units , MCBs , terminal blocks etc. suitable for application			
6.00.00	PROCESS CONNECTION & PIPING			
6.01.00	Process connection & piping including all impulse piping, sample piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories required for proper installation & completeness of impulse piping system, sampling piping system and air supply system, as stipulated under Sub-section PCP, Part-B, Section-VI of Technical Specification.			
6.02.00	Local Instrument Enclosure (LIEs) shall be provided to group & mount transmitters & process actuated switches in open and dust prone environment like Boiler/Mill area. Local instrument Racks (LIRs) shall be provided to group & mount transmitters and process actuated switches in cleaner areas like TG hall. LIE/LIRs are not required for Fuel Oil applications and off site areas.			
7.00.00	INSTRUMENTATION CABLES, POWER SUPPLY DISTRIBUTION CABLES & CABLES SUB-TRAYS			
7.01.00	All instrumentation cables twisted & shielded, FRLS PVC insulated, including thermocouple extension cables and prefabricated cables (with plug-in connectors), Power Supply cables, optical fiber cables other than shown in exclusion, as applicable for interconnection of all equipment/system/devices in Contractor's scope as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR/Fuel Oil handling System/Temperature Transmitter (even if they are not in Contractor's Scope.) Etc. along with necessary laying & termination accessories, hardware etc. meeting requirements specified under Sub-section INST CABLE, Part -B, Section-VI of Technical Specification. All sub trays along with supporting, connecting hardware etc. required for laying of instrumentation, control, power and other cables etc. up to main cable trays are under Bidders scope.			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES																							
8.00.00	CONTROL VALVES & ACTUATORS																							
8.01.00	Control valves, actuators and accessories, shall be provided meeting requirements specified under Sub-section CONTROL VALVE, Part-B, Section-VI of Technical Specification. Specially designed valves/trims to prevent cavitation and limit noise and control outlet velocity, shall be provided.																							
8.02.00	Microprocessor Based Electronic Positioner is to be provided with all the Control valves and all control dampers being provided by the contractor.																							
9.00.00	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS																							
9.01.00	Instrumentation and Control System with interlocks, protection and annunciation of the mechanical common auxiliary systems as mentioned below shall be provided. Instrumentation for this system shall meet the requirement stipulated under Sub-section Aux. Plant. Ctrl, Part -B, Section-VI of Technical Specification. All necessary equipments / system for control, monitoring and operations of the plants as well as the incomers and bus couplers shall be provided.																							
9.02.00	For the following plants control systems shall be provided as indicated below:- <table><tr><th>SI No</th><th>Auxiliary Plant</th><th>Control System</th><th>Interconnection</th></tr><tr><td>01</td><td>Auxiliary Boiler</td><td>Independent control system in SG-C&I based Hardware</td><td>Dual two way Ethernet Connectivity to Station LAN for information and Control.</td></tr><tr><td>02</td><td>Fuel Oil Pressurisation/ Heating System (FOPH) & Fuel Oil Unloading System</td><td>Independent control system in SG-C&I based Hardware.</td><td>Dual two way Ethernet Connectivity to Station LAN for information and Control. Local operation of Fuel oil Handling System through GIU.</td></tr><tr><td>03</td><td>Mill Reject System (unitized system)</td><td>SG C&I Based Control System from Control Room</td><td>Graphical Interface unit(GIU) based local operation apart from CCR.</td></tr><tr><td>04</td><td>Air Compressor System (including compressors of mill reject system)</td><td>If the controller is integral to compressor Microprocessor/PLC based control system as per vendor's practice for individual Air Compressors control. If the controller for individual compressors is</td><td>Dual two way Ethernet Connectivity to Station C&I system for information and Control of Individual Air Compressors (Applicable only for Compressors with Integral controllers)</td></tr></table>				SI No	Auxiliary Plant	Control System	Interconnection	01	Auxiliary Boiler	Independent control system in SG-C&I based Hardware	Dual two way Ethernet Connectivity to Station LAN for information and Control.	02	Fuel Oil Pressurisation/ Heating System (FOPH) & Fuel Oil Unloading System	Independent control system in SG-C&I based Hardware.	Dual two way Ethernet Connectivity to Station LAN for information and Control. Local operation of Fuel oil Handling System through GIU.	03	Mill Reject System (unitized system)	SG C&I Based Control System from Control Room	Graphical Interface unit(GIU) based local operation apart from CCR.	04	Air Compressor System (including compressors of mill reject system)	If the controller is integral to compressor Microprocessor/PLC based control system as per vendor's practice for individual Air Compressors control. If the controller for individual compressors is	Dual two way Ethernet Connectivity to Station C&I system for information and Control of Individual Air Compressors (Applicable only for Compressors with Integral controllers)
SI No	Auxiliary Plant	Control System	Interconnection																					
01	Auxiliary Boiler	Independent control system in SG-C&I based Hardware	Dual two way Ethernet Connectivity to Station LAN for information and Control.																					
02	Fuel Oil Pressurisation/ Heating System (FOPH) & Fuel Oil Unloading System	Independent control system in SG-C&I based Hardware.	Dual two way Ethernet Connectivity to Station LAN for information and Control. Local operation of Fuel oil Handling System through GIU.																					
03	Mill Reject System (unitized system)	SG C&I Based Control System from Control Room	Graphical Interface unit(GIU) based local operation apart from CCR.																					
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			not integral to compressor then control shall be through station C&I (In Employer's Scope). For both the cases Over all Control shall be through Station C&I Package (in Employer's scope).	
	05	Equipment Cooling Water System (Instrumentation in Contractor's scope)	Control from Station C&I Package	
	06	HP Dosing system (Instrumentation in Contractor's scope)	Control from Station C&I Package	
	07	Flue Gas Desulphurisation (FGD) System	PLC Based Control System	Dual two way Ethernet Connectivity to Station LAN for information and Control.
10.00.00	TYPE TEST REQUIREMENT			
10.01.00	The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section CNI TYPE TEST, Part-B, Section-VI of Technical Specification.			
11.00.00	PLANT PERFORMANCE ANALYSIS, DIAGNOSIS & OPTIMIZATION SOFTWARE			
11.01.00	The Contractor shall provide a PC based On-line Plant Performance Analysis, Diagnosis & Optimization system (PADO) for the station, which will provide proper guidance to the plant operator. The PADO shall incorporate the complete thermal design/model of each unit. The model of each unit shall work together from the same PC for the complete plant. The system shall use the measured data from the DDCMIS through appropriate interface to be provided by the bidder through Station LAN of Station C&I package.			
11.02.00	The PADO system shall provide the following functions in a modular and seamlessly integrated environment, using a common plant model and a dynamically shared database. (i) Performance analysis and monitoring of systems and components. (ii) Emission Analysis and monitoring. (iii) System and performance diagnosis. (iv) System and performance optimization.			
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	(v) Boiler performance optimization including optimized operation of soot Blowing system. (vi) Boiler stress condition analysers. (vii) Interactive water and gas chemistry management system. (viii) Regenerative cycle performance optimization system.			
11.03.00	All the software, hardware, instruments etc. which will be required to implement the above at Contractor's end shall be in the scope of Contractor, even if the same is not indicated in the tendser drawings & other sections of the specification.			
12.00.00	TOOLS & TACKLES			
12.01.00	The Contractor shall furnish a complete new set of all special tools and tackles of reputed make and model which are required for erection, ease in maintenance to have minimum down time, testing and calibration of all the equipments and systems to be provided by the Contractor under this specification for C&I systems.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		PAGE 8 OF 8
		SUB-SECTION-IIIC C&I		

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	
III D	CIVIL WORKS FOR STEAM GENERATOR & AUXILIARIES PACKAGE	
1.00.00	SCOPE OF CIVIL WORKS	
1.01.00	Scope of Contractor for Civil Works shall include but not be limited to the design, supply and erection of the following:	
1.01.01	All supporting steel structures (excluding foundation which shall be provided by Employer) for the areas, plants, systems and facilities (including all piping/cables/ducts therein) as mentioned below: a) Steam Generator & Auxiliaries b) Electro Static Precipitator (ESP) c) Power cycle piping consisting of MS, HRH, CRH and auxiliary steam piping d) Mill reject handling system e) Compressed Air System f) Auxiliary Boiler g) FGD System	
1.01.02	All supporting steel structures for Boiler Elevator, cladding for elevator enclosure, machine room for elevator including structural steel beams for machine room floor, roof & wall beams, etc.	
1.01.03	All interconnecting steel platforms, between Boiler & Main Power House and Boiler & Mill Bunker Building, with associated ladders/stairs, gratings, handrails, etc.	
1.01.04	All anchor fasteners, foundation bolts along with templates, inserts and embedments, along with lugs, pipe sleeves with lugs, monorail beams, etc., complete whatsoever required for supporting equipment and structures	
1.01.05	All miscellaneous steel structures such as gratings, handrails, ladders/stairs, platforms, edge protection angles/tees on equipment foundations, etc.	
1.01.06	Dressing of foundations, grouting of pockets and underpinning of base plates for structures/ equipment, etc.	
1.01.07	Furnishing of foundation loading data, anchor bolts plans, pocket details, equipment mounting details, opening details on floor / walls / cladding / roof, embedments and inserts details, etc., in the form of input drawings to the Employer, for the Employer's engineering work	
1.01.08	Fixing supports, filling and finishing of openings for pipes/cables/ducts in floors/walls/cladding/roof, etc.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.01.09 1.01.10 1.01.11 1.01.12 1.01.13 1.01.14 1.01.15 1.01.16 1.01.17 1.01.18	PTFE bearings for supporting of Contractor's structures on Employer structure Corrosion protection painting for structures Painting of portions of Employer structures wherever connection/welding is carried out by Contractor for supporting his structures All rectification including painting of Employer structures which are damaged by Contractor during his work Sheeting work for roof (penthouse)/ canopy/ side cladding of Steam Generator and ESP Placement of the embedments/anchor bolts supplied by the Contractor, shall be done by the Employer. However the accuracy of the embedments/anchor bolts in plan and elevation shall be checked and ensured by the Contractor during the placement of the same. Any modification required on these embedments/anchor bolts subsequent to their placement shall be done by the Contractor. Supply, installation and erection of steel helical spring and viscous dampers for PA, FD & ID fans shall be Contractor's scope. All fixtures, inserts, embedments, etc. for Elevator for ESP control room shall be in Contractor's scope. Any other facilities / structures that would be required, as per the system requirements covered under various sections / chapters of this specification but not covered here above. Detailed technical requirements for Civil Works are covered elsewhere in the specification			
2.00.00	CONSTRUCTION FACILITIES The following are also in the Contractor's scope of work : - Providing drinking and service water for Bidder's labour, staff and other personnel working for Bidder at the work site and in his staff/labour colony. He shall install necessary borewells with associated pumping and treatment facilities to supply quality water as per standards. - Developing temporary staff colony and labour colony along with fencing etc. - Providing all arrangements for distribution of construction power at various locations as per his requirements from the supply point of Employer. - Providing all arrangements for the supply of construction water including bore-wells. - Providing temporary construction office, construction stores (open / covered), workshops, material / field testing laboratory, any other temporary buildings			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IIID CIVIL WORKS	PAGE 2 OF 4	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	6. Providing all construction equipment, labour and materials. The Bidder shall provide all the tools and tackles required for the work. 7. Development of the pre-assembly and storage yard with fencing, drainage, internal roads, boulder soling, etc 8. Construction and maintenance of roads between boiler and ESP and access roads to his work sites, offices, stores etc. as required for providing approach/access for men, materials, equipment and construction/erection activities. Rectification of damage of roads (constructed by the Employer) caused by the Contractor. 9. Area lighting at the construction / erection site, pre-assembly and storage yard, office areas and labour / staff colony. 10. Providing all necessary fire fighting devices / equipment / fire tender etc. required during the project execution stage. He shall maintain all such equipment / devices in proper working conditions throughout the period of work. 11. Providing first aid facilities at the construction / erection sites, workshops, laboratories, pre-assembly and storage yard and other places of work as per the requirement. 12. The Contractor shall arrange skilled / semiskilled / unskilled manpower from local source(s) as far as available in this country. He shall also arrange supervisory staff for quality execution of all works in his scope. 13. Contractor's office, store, workshop, laboratory or any other temporary buildings: The Contractor shall adopt pre-engineered/ pre-fabricated constructions made of steel with single / double skin, insulated for un-insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store workshop, laboratory or any other temporary buildings. Alternatively, bidder can adop readymade `Portacabin' or similar construction. Bidder shall ensure that all such constructions are well-engineered, neatly constructed and overall present a pleasing look. The above requirements shall be applicable to his sub-vendors also and bidder shall be responsible for enforcing the same on his sub-vendors. 14. Use of ash and ash based products: In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, Bidder shall use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ahs and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Contractor shall be responsible for enforcing the same on his sub-vendors.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IIID CIVIL WORKS	PAGE 3 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			एनटीपीसी NTPC
	15. Repair & Maintenance Facilities by the Bidder: Bidder shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like cranes, hydra, forklifts, welding equipments, etc.) He will also make arrangements/tie up with manufacturers/suppliers of such construction plant, equipment & machinery, for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various construction plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Bidder shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		PAGE 4 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES															
1.00.00	SCOPE OF SUPPLY AND SERVICES															
1.01.00	The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, manufacture, engineering, inspection and testing at suppliers works, packing, forwarding to site, unloading, erection, supervision, pre-commissioning, testing and commissioning and performance testing of the equipment/system and works indicated in this Sub-section of the technical specification. Any item or works though not specifically mentioned in this specification but needed to complete the equipment & systems to meet the intent of the Specification shall also be furnished, unless specifically mentioned under "Exclusion" in Sub-Section-IV of Part-A, Section-VI of the Technical Specifications.															
1.02.00	The scope of work is detailed out in this Part-A of the Technical Specification, Section-VI and is elaborated below : Sub-Section <table><tr><td>IIIA</td><td>-</td><td>Mechanical equipment and systems</td></tr><tr><td>IIIB</td><td>-</td><td>Electrical Systems</td></tr><tr><td>IIIC</td><td>-</td><td>Control & Instrumentation</td></tr><tr><td>IIID</td><td>-</td><td>Civil Works</td></tr></table>				IIIA	-	Mechanical equipment and systems	IIIB	-	Electrical Systems	IIIC	-	Control & Instrumentation	IIID	-	Civil Works
IIIA	-	Mechanical equipment and systems														
IIIB	-	Electrical Systems														
IIIC	-	Control & Instrumentation														
IIID	-	Civil Works														
1.03.00	Scope of supply of the Contractor includes mandatory spares, start-up and commissioning spares and Unit Assemblies. The general requirements in respect of various types of spares and Unit Assemblies is given in Sub-Section-VII and Sub-Section-VIII, Part-A of Technical Specification.															
1.04.00	Type Tests The scope of the bidder includes all shop tests, type tests, site tests, routine tests, etc. fulfilment of complete quality assurance & inspection requirements and related activities for all the equipment & systems covered under the scope of work of bidder as per the stipulations of Technical Specifications.															
1.05.00	Paints / Painting The Contractors scope of works includes supply of paints and painting of all equipment and structures as per the Employer's standard color coding scheme which shall be furnished to the Contractor during detail engineering stage. The painting of various components shall comply with the requirements stipulated in different part of this specification. However, for components where no specific requirement is stipulated, the painting confirming to the requirements stipulated below shall be provided. The quality and finish of paints shall be as per standards of BIS or equivalent. (a) The surfaces which have surface temperature 95⁰C or less and which are insulated, shall be painted with at least two coats of inorganic zinc silicate primer & two coats of enamel paint with total DFT not less than 80 microns.															
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI , PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III	PAGE 1 OF 4												

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 			
	(b) All surfaces having temperature above 95 degree Celsius and which are insulated shall be applied with at least two coats of high temperature special paint with total DFT not less than 40 microns. (c) SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection. (d) Painting specification for all other exposed steel surfaces not covered above shall be same as that given in Civil Sub-section, Part-B, Section VI for corrosion protection of steel structures.			
1.06.00	Pre-commissioning and Commissioning Activities			
1.06.01	Contractor's Scope shall include all pre-commissioning and commissioning activities, required for successful performance of all equipments and systems under this package and shall include, but will not be limited to, activities detailed in Sub section VII of Part-B of Technical Specification. Contractor scope shall also include supply of all materials and services including the following for successful conductance of pre-commissioning and commissioning activities:			
1.06.02	Complete pre-commissioning work including tests of facilities such as line flushing, hydraulic testing of pressure parts, air and gas tightness tests of steam generator enclosure, duct work and ESPs, chemical cleaning of pressure parts, steam blow off, gas distribution test of ESPs etc. and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.			
1.06.03	Commissioning and Initial Operation of the facilities			
1.06.04	Supply of all consumables (except coal and fuel oil for firing and lime stone for FGD plant) like chemicals for chemical cleaning, passivation, inhibition etc., oil for line flushing, nitrogen for blanketing, consumables for air/gas tightness tests and any other consumable as may be required for above pre-commissioning/commissioning activities.			
1.06.05	Supply of all temporary equipments such as tanks, piping, including supports, valves, nitrogen blanketing equipments including nitrogen cylinders, pumps and all necessary instrumentation for successful conductance of pre-commissioning and commissioning activities.			
1.06.06	The temporary equipments specifically brought by the Contractor solely for the pre-commissioning and commissioning work shall on completion of these activities, remain the property of the Contractor. However, the nitrogen blanketing equipment including nitrogen cylinders shall get included in the Contractor's permanent scope of supply and become property of the Employer.			
1.06.07	The selection of material of all the temporary equipments/instruments shall be compatible with the service conditions expected during pre-commissioning / commissioning activities.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI , PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III	PAGE 2 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.06.08	All temporary equipments and instruments shall be clearly listed out in the bid.			
1.06.09	Supply of all labour, skilled / semi skilled supervisors, engineers and any other manpower.			
1.07.00	First Fill of Consumables, Oil & Lubricants All the first fill and one year's topping requirements of consumable such as grease, oil, lubricants, servo fluids, essential chemicals, etc. which will be required to put the equipments covered under the scope of specifications, into successful commissioning / initial operation and to establish completion to facilities shall be furnished by the bidder, unless specifically excluded under the Exclusions in these specifications and documents.			
1.08.00	Guarantee Tests The Guarantee tests for various equipment and systems shall be carried out as specified under Sub-Section-VI, Part-A of Technical Specification. All special equipment, tools and tackles, instruments, measuring devices required for the successful conductance of Guarantee Tests shall be provided by the bidder, free of cost. All costs associated with the tests shall be included in bid price.			
1.09.00	Spare Parts The Contractor's scope of supply includes all unit assemblies, the necessary commissioning spares, mandatory spares as described below in the schedule of spare parts. The Employer reserves the right to finalize the exact quantities of the spare parts and effect price adjustment on the basis of the rates quoted by the Contractor. The Spare ordered by Employer shall be delivered at the site as per agreed delivery schedule.			
1.09.01	Mandatory Spares The Bidder shall indicate the prices for each & every item (except for items not applicable to the Bidder's design) in the 'Schedule of mandatory Spares' whether or not be considers it necessary for the purchaser to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spares items, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item. Wherever sets are mentioned, the bidder has to give the item details & prices of each item.			
1.09.02	Recommended Spares In addition to the spares mentioned above, the bidder shall also indicate in the 'Schedule of recommended list of spare parts', his recommended list of spare with unit prices, for three years of normal operation of the plant. The Employer reserves the right to buy any or all of the recommended spare parts. The bidder shall also indicate the service expectancy period for the spare parts under normal operating conditions before the replacement is necessary. In case some of the spares parts become unapplicable due to change in design/engineering agreed by the Employer, the Employer reserves the right to procure some other spares whose prices are			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI , PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III	PAGE 3 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	already available in the initial offer in lieu of such not applicable spares subject to the condition that the total amount of the initial order remains the same.			
1.09.03	Commissioning Spares It will be the responsibility of the Contractor to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Contractor within 12 months from the date of LOA, separately for each equipment and shall be reviewed by NTPC and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the Initial Operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Contractor of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Contractor as a part of the respective equipment package at no extra cost to the Employer.			
1.09.04	Packing & Preservation Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease / lubricants from imported origin, the supplier shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Employer to procure these items from indigenous sources.			
1.10.00	Special Tools & Tackles and Test / Measuring Equipments One set of all special tools and tackles including testing, calibrating and measuring instruments required for erection, assembly, disassembly and maintenance of all equipments/systems covered under the scope of the bidder shall be supplied by the bidder as per the relevant clauses of Technical Specifications. These shall not be used for erection / commissioning purposes and shall be in an unused and new condition, when they are handed over to the Employer. A list of such special tools and tackles shall be submitted alongwith the offer.			
1.11.00	The scope of the bidder includes complete design and engineering, technical co-ordination (including participation and arranging technical co-ordination meetings), finalization of drawings / documents, submission of engineering drawing / documents and processing of their approvals by the Employer as detailed in Part-C, Section-VI and other relevant clauses given elsewhere in the technical specification. Further, the scope shall also include submission, in proper shape & format, of all types of manuals, handbooks & documents in requisite numbers to the Employer at different phases of the project as per the requirement of employer.			
1.11.01	Bidder shall furnish all relevant data required by the Employer, at interface points within 45 days of notification of award.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI , PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-III PAGE 4 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC															
1.00.00	FLUE GAS DESULPHURIZATION SYSTEM The engineering, design supply and installation of FGD system and the associated auxiliaries shall comply with the applicable safety code and regulation of the locality where the system is being installed and meet all the guarantees stipulated in Part-A of the specification. The absorber and auxiliaries shall be designed in accordance with the requirements specified in this sub-section. Nothing in this specification shall be construed to relieve the contractor of his responsibility of ensuring a safe and reliable design of the system capable of meeting all the statutory norms and guarantees stipulated in the specification. Any equipment/pipe/valve required for completion and safe and reliable operation of the system, but not covered in this chapter, as per the standard design of the supplier shall also be supplied. The contractor shall supply only proven design in similar applications for the system. The owner intends to sell the gypsum produced from the FGD system for sale in the commercial market. The gypsum produced from the system shall be stored in silos for later off-take or sale. The contractor shall supply all the equipments necessary to produce gypsum cake of saleable quality. The gypsum dewatering system provided for this purpose shall be capable of producing gypsum with purity not less than 90% and residual moisture not more than 10%. The complete FGD system and the associated auxiliaries shall be designed by the standard industrial practices. Only field proven materials for similar application shall be used for the system.																
1.01.00	Type of FGD System The FGD system shall be installed downstream of the ID fans and shall be based on wet Limestone Forced Oxidation Process. The FGD system shall be designed to achieve the required SO₂ capture without the use of oxalic acid or any other additives.																
1.02.00	The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated under 'Guarantee Point' and 'Design Point' conditions indicated below: <table><thead><tr><th>Sl. No.</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr></thead><tbody><tr><td>1</td><td>Boiler Load in MW (e)</td><td>250 MW</td><td>250 MW</td></tr><tr><td>2</td><td>Type of Coal</td><td>Design coal</td><td>Worst coal</td></tr><tr><td>3</td><td>Ambient air condition</td><td>27deg. C temp. and 60% RH</td><td>42deg. C temp. and 60% RH</td></tr></tbody></table>	Sl. No.	Item	Guarantee Point	Design Point	1	Boiler Load in MW (e)	250 MW	250 MW	2	Type of Coal	Design coal	Worst coal	3	Ambient air condition	27deg. C temp. and 60% RH	42deg. C temp. and 60% RH
Sl. No.	Item	Guarantee Point	Design Point														
1	Boiler Load in MW (e)	250 MW	250 MW														
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BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-II M-04 FLUE GAS DESULPHURISATION SYSTEM														
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	3. Short temp excursion 300 temperature of inlet gas (for approx. thirty (30) minutes at a time) (deg. C) 4. Inlet Dust Burden in Gas 200 (mg/Nm³) 5. Maximum flue gas velocity Not more than 4 m/s at Design Point through the Absorber (M/sec) Conditions 10. Recirculation Slurry pH Not less than 5.5 under all operating conditions			
2.02.00	Design			
2.02.01	The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No. 15.00.00, sub-section II M-01, Part-B of this specification.			
2.02.02	All ducts with operating temperature above 60°C shall be insulated in accordance with Cl. No. 21.00.00, sub-section II M-01 Part-B of this specification.			
2.02.03	The duct layout shall ensure that there is no accumulation of acid mist on the duct floor. The absorber outlet duct shall not have any horizontal section for this purpose.			
2.02.04	The gas duct from Gas-Gas Heater (GGH) outlet to Absorber, from Absorber outlet to GGH and from GGH to stack shall be made of min. 7mm thick carbon steel of structural grade with a 2mm thick (minimum) lining / cladding / wallpaper of SS 317 LMN or equivalent. Alternatively, the ducts from Absorber outlet to GGH may be provided with a flaked glass lining, if the contractor has experience of the same. Lining shall be attached properly to the base to ensure that the base material does not come into contact with the corrosive gases under any circumstance. Sufficient overlap of the lining material shall be provided.			
2.02.05	In addition to the base offer as described above, the bidder may also submit an alternate offer for a different material / lining of duct from GGH outlet to stack, if the bidder has previous experience of the same. The bidder should have supplied a similar design of duct in previous installations for similar application. Bidder shall indicate the applicable price implication for such an alternate offer in the relevant Bid Proposal sheet. The bidder shall also furnish details of the previous installations of such system and bring out all the technical features of the system proposed.			
2.02.06	All guide vanes & internal trusses (if provided) shall be made of SS 317LMN or better material.			
2.02.07	Wherever required, expansion joints of proven design shall be provided in the ducts to take care of differential expansion in the system. The material chosen for expansion joints from the FGD inlet isolation gates to the chimney inlet shall be suitable for the duty conditions and the corrosive atmosphere of the FGD system and shall be field proven for similar applications. The expansion joint shall have a minimum guaranteed life of not less than 20000 hrs. of operation.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-II M-04 FLUE GAS DESULPHURISATION SYSTEM	PAGE 3 OF 18

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.03.00	Gates & Dampers			
2.03.01	The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. For this purpose. Motorized/Pneumatic Guillotine type gates shall be provided at hot gas inlet to GGH, cold gas outlet from GGH and the bypass duct.			
2.03.02	The gate in the bypass duct shall be of quick opening type to allow bypass to come into operation in case of emergency.			
2.03.03	All the gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness without seal air along the duct as well as from the duct to atmosphere.			
2.03.04	The absorber isolation gates shall be provided with 1x100% seal air fan. 2x100% seal air fans shall be provided for the bypass gate. The gates shall be 100% leak tight with seal air fans under the above conditions.			
2.03.05	The blade and other components in the gas path, of the guillotine gates in the bypass duct and at GGH outlet (cold gas) shall be made of SS317L or better material. The seals shall be made of Alloy C-276 or better material.			
2.03.06	The gates shall be power / pneumatically operated and shall be controlled from the control room. Provision shall be made for automatic bypass of the absorber in case of failure of the absorber spray system or the GGH. The gates shall have provision for manual operation, through a hand wheel. The force required for manual operation of the gate shall not exceed 35 kg (max.) at the rim of the hand wheel.			
2.03.07	The isolating gates shall be provided with locking devices to permit locking in fully closed position.			
3.00.00	GAS GAS HEAT EXCHANGER (GGH)			
3.01.00	Type			
3.01.01	The GGH shall be Rotary Regenerative (Ljungstrom type or equivalent) with rotating matrix with vertical axis of rotation. Alternatively, the contractor may provide a Heat Pipe type heat exchanger, with carrier fluid circulated by natural circulation or by circulation pump, if it is the contractor's standard practice and the contractor has previous experience of supplying such a system for similar applications. The contractor shall provide only proven design of GGH which has been in successful operation for a minimum period of one year in similar application in plants of similar or higher capacity.			
3.02.00	Sizing			
3.02.01	There shall be one (1 no.) Gas Gas Heater at the inlet to the absorber.			
3.02.02	The GGH shall be sized to achieve a minimum cold gas exit (stack inlet) temperature of 100°C under the Guarantee Point conditions.			
3.02.03	The sizing the Gas-Gas Heater shall be sufficient to maintain a stack Inlet Temperature of 80°C even at 50% TMCR with the range of coals specified. Note: The above temperatures shall be uncorrected i.e., without considering any leakage through the GGH.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.02.04	The design of the GGH shall ensure that leakage through the seals does not exceed 1.5% of the hot gas inlet flow from 50% TMCR to 100% BMCR. For this purpose, the contractor may provide an on-line automatic leakage control system, if he has previous experience of the same. The contractor may also provide seal air fans to minimize the leakage across the seals, if he has previous experience of the same. 2x100% seal air fans with motorized isolation gates at the discharge of each fan shall be provided in such a case. The above leakage shall be guaranteed by the contractor and demonstrated after 3000hrs of operation. No shut down or internal adjustment of the seals shall be permitted during the above period.			
3.02.05	Heat pipe heat exchanger shall be fully gas tight with zero leakage.			
3.03.00	Design			
3.03.01	The GGH components shall be made of corrosion resistant materials to withstand the aggressive atmosphere encountered in FGD application.			
3.03.02	In case the contractor offers, pipe type heat exchanger, the heat carrier fluid shall be water. 2x100% pumps shall be provided if pumping is used for circulation. The materials selected for tube, fins and casing shall be capable of withstanding the corrosive atmosphere and shall be proven by successful application in previous designs of the supplier. The fin pitching of the tubes shall be selected to avoid deposition of ash and acid condensate and shall take into account a minimum inlet dust burden of 200 mg/Nm ³ .			
3.03.03	In case the contractor offers, a rotary regenerative type GGH, it shall be driven by a peripheral A.C. motor through a reduction gear box. An emergency air motor, with automatic clutching/de-clutching arrangement shall also be provided. The GGH shall have sump lubricated, oil cooled bearings. 2x100% oil circulation pump shall be provided for each bearing. The heating elements shall be arranged in easily removable groups of baskets. The contractor shall provide: i. Rotor stand-still device with alarm. ii. Thermocouples/ RTD for each bearing. iii. Adequate instrumentation in the lube oil system for detection of any malfunctioning. iv. Observation ports with lights. v. Complete facility for removal of basket and placement on floor, including removal gear, handling facility (complete with structure, runway beams, hoists, storage space etc.)			
3.03.04	In case the contractor offers a Rotary regenerative heater, the shaft shall be made of corten steel or better material. The heating elements shall be made of enameled steel or better material. The housing, seal plates and other components in the gas path shall be carbon steel lined with stainless steel or glass flaked resin lining, as per the proven practice of the contractor for similar application.			
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3.03.05	The contractor shall provide suitable arrangement for on load cleaning system for cleaning the heat transfer elements. The cleaning system shall use high pressure water. In case of pipe type GGH, the cleaning system shall be provided both on dirty and clean gas sides of the exchanger. All pumps required for the above purpose shall be provided by the contractor.			
4.00.00	ABSORBER			
4.01.00	The contractor may offer either a spray type absorber, with single or multiple levels of spray, or an absorber with gas bubbling through the slurry, as per his proven practice. Only proven system in successful operation in previous installations supplied by the contractor shall be offered. A. Spray System (if offered) i. The contractor shall provide spray system and minimum spray levels required to meet the stipulated guarantee and design requirement. The spray system (including slurry recirculation pump & nozzles) shall be sized to achieve the desired L/G ratio required to meet the guarantees SO₂ removal efficiency, with redundancies specified under this clause. ii. In case the contractor offers an absorber with multiple levels of spray nozzles, each spray level shall be provided with independent 2x100% pumps. Alternatively, the contractor may offer a spare spray level with each spray level served by an independent 100% capacity pump. In case the contractor offers a single level of spray, 3x50% slurry recirculation pumps shall be provided. The contractor shall provide spray system / spray levels only as per his proven practice, which should be in successful operation elsewhere. iii. The slurry recirculation pumps shall have a minimum margin of 10% of flow and head, over the actual requirement for meeting the guarantee and design point conditions. iv. The slurry pumps shall comply with the requirements stipulated in Clause 7.00.00 of this sub-section. v. Sufficient redundancy, as per the proven practice of the contractor, shall be provided in the spray nozzles. Minimum 10% spare nozzles shall be provided at each level. B. Bubbling Type Absorber i. In case the contractor offers a bubbling type absorber, the gas distribution system shall be sized with sufficient margin for choking of nozzles/holes.			
4.02.00	Absorber Recirculation Tank Sufficient number of agitators, as per the proven practice of the contractor, shall be provided for thorough mixing of the re-circulating slurry. However, these shall be at least one redundant agitator.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC										
4.03.00	Absorber Oxidation Systems													
4.03.01	The contractor may offer either a grid type oxidation system or a sparge jet oxidation system, for oxidation of sulfite sludge to sulfates, as per his proven practice.													
4.03.02	The oxygen required for oxidation shall be supplied by 2x100% oxidation air compressors for each absorber. The compressor shall be sized to supply atleast 2.5 times the stoichiometric air requirement or the actual requirement, whichever is higher, under the following condition, all occurring simultaneously. The natural oxidation of sulfite by residual oxygen in flue gas shall not be considered for this purpose. <table><tr><td>a. Load</td><td>100% BMCR</td></tr><tr><td>b. Flow</td><td>Minimum 2. 5 times the stoichiometric requirement with boiler firing any coal from the specified range of coals whichever gives the maximum air requirement under above conditions.</td></tr><tr><td>c. Head</td><td>Actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers.</td></tr><tr><td>d. Margin on Head</td><td>10% under above conditions.</td></tr><tr><td>e. Ambient Conditions</td><td><u>42°C / 60% RH.</u></td></tr></table>				a. Load	100% BMCR	b. Flow	Minimum 2. 5 times the stoichiometric requirement with boiler firing any coal from the specified range of coals whichever gives the maximum air requirement under above conditions.	c. Head	Actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers.	d. Margin on Head	10% under above conditions.	e. Ambient Conditions	<u>42°C / 60% RH.</u>
a. Load	100% BMCR													
b. Flow	Minimum 2. 5 times the stoichiometric requirement with boiler firing any coal from the specified range of coals whichever gives the maximum air requirement under above conditions.													
c. Head	Actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers.													
d. Margin on Head	10% under above conditions.													
e. Ambient Conditions	<u>42°C / 60% RH.</u>													
4.03.03	Oxidation nozzles / spargers shall have a minimum redundancy of 10% or as per the contractor's proven practice whichever is maximum.													
4.04.00	Gypsum Bleed Pump Each absorber shall be provided with 2x100% Gypsum Bleed Pumps for supply of gypsum slurry to Gypsum Dewatering system. Each Gypsum bleed pump shall be sized to bleed-off the gypsum slurry from the absorber with slurry solid concentration not exceeding 30%, under the following conditions, all occurring simultaneously: <table><tr><td>a. Load</td><td>100% BMCR</td></tr><tr><td>b. Flow</td><td>100% of gypsum produced with Boiler firing any coal from the specified range of coals whichever gives the maximum gypsum flow from the absorber</td></tr><tr><td>c. Head</td><td>As per system requirement</td></tr><tr><td>d. Margins</td><td>Flow -- 15%</td></tr><tr><td></td><td>Head – 20%</td></tr></table> The pumps shall be designed to meet the stipulations of Clause No. 7.00.00 of this Sub-Section.				a. Load	100% BMCR	b. Flow	100% of gypsum produced with Boiler firing any coal from the specified range of coals whichever gives the maximum gypsum flow from the absorber	c. Head	As per system requirement	d. Margins	Flow -- 15%		Head – 20%
a. Load	100% BMCR													
b. Flow	100% of gypsum produced with Boiler firing any coal from the specified range of coals whichever gives the maximum gypsum flow from the absorber													
c. Head	As per system requirement													
d. Margins	Flow -- 15%													
	Head – 20%													
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.05.00	Design			
4.05.01	The design and arrangement of the absorber shall be field proven for successful long-term operation in conjunction with a coal fired power plant.			
4.05.02	The absorber shall be designed to withstand the maximum pressured developed by the ID fan.			
4.05.03	Provision shall be made for automatic spray of quenching water at the inlet to the absorber, in case the gas temperature exceeds the design temperature due to failure of upstream equipments. For this purpose an emergency water tank shall be provided for each absorber.			
4.05.04	Two stage chevron type mist eliminators made of FRP or polypropylene shall be provided at the exit of the absorber before entry into GGH. Provision shall be made for continuous washing of both ends of the first stage and the front section of the second stage of mist eliminators. Wash water arrangement shall also be provided at the back end of the second stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated.			
4.05.05	The absorber oxidation tank shall be provided with an over flow line complete with sealing pot, over flow and drain line. The absorber over flow shall be taken to a sump in the absorber region, from where the slurry shall be pumped back to the absorber by a sump pump.			
4.05.06	The absorber shall be made of 7 mm thick mild steel with corrosion resistant metallic lining to avoid corrosion of the base material.			
4.05.07	The absorber wet-dry interface and the oxidation tank shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. Sufficient protection shall be provided for the base of the tank to prevent mechanical damage, particularly during maintenance.			
4.05.08	The absorber tower & outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of SS 317 LMN / Alloy 31 or better material.			
4.05.09	The spray headers (if provided) and air supply headers shall be made of FRP or rubber lined Carbon Steel, corrosions and erosion resistant in the inner and outer side. The spray nozzles shall be of silicon carbide.			
4.05.10	The absorber shall be self-supported from the bottom to suit site conditions. The absorber shall have adequate stiffening arrangement on the external side. Internal stiffeners shall be used only where it is not possible to provide proper external stiffening. All internal members shall be made of Stainless Steel 317LMN.			
4.05.11	It should be possible to build platforms inside the absorber for access to all parts of the absorber during maintenance. In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels. Arrangement shall be properly designed to facilitate access for maintenance and replacement of spray nozzles.			
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4.05.12	The spray piping, mist eliminators and its supporting structure shall be designed to carry sufficient load during maintenance.		
5.00.00	LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM		
5.01.00	Type A common limestone and slurry preparation system is envisaged for all the units. Contractor shall supply wet limestone grinding and slurry preparation system complete with all auxiliaries and slurry storage tank of proven design.		
5.02.00	Bunker Shut-off Gates		
5.02.01	A bunker outlet chute shall be provided for feeding limestone from bunker to the feeder. The size of the opening chute shall be sufficient to ensure proper flow of the limestone. There shall be no reduction of section in the bunker outlet chute from bunker to feeder. A motorized bunker shut-off gate shall be provided at the inlet to each feeder.		
5.02.02	All parts of the gate in contact with limestone shall be of stainless steel construction.		
5.02.03	The shut-off gates and its actuator shall ensure 100% closing of the gate even with 'bunker full of limestone'.		
5.02.04	Facility shall be provided to open/close the bunker outlet gate, through actuator, from remote as well as local.		
5.02.05	In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of coal.		
5.02.06	For each bunker facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes.		
5.03.00	Gravimetric Feeders		
5.03.01	Gravimetric feeders shall be sized to meet 110% of the maximum mill capacity.		
5.03.02	The limestone feeder belt shall be of seamless rubber construction. It should be possible to adjust the belt tension from outside without opening the feeder body.		
5.03.03	All parts in contact with limestone except belt shall be of stainless steel construction.		
5.03.04	The feeder shall have adequate instrumentation to detect `loss of flow'.		
5.03.05	The feeder shall have a motor/pneumatic operated gate at the outlet.		
5.04.00	Wet Ball Mill		
5.04.01	There shall be five (5 nos.) tube mills for grinding of limestone. Each mill shall be sized to meet 110% of the maximum limestone requirement of one unit under the following conditions, all occurring together.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	i. Load ii Flow iii Input Limestone Size iv Output Fineness v. Mill Wear Part Conditions 100% BMCR 110% of limestone requirement of one absorber with Boiler firing Design/Worst/Best whichever gives the maximum limestone requirement. 1" (min.) 90% or higher (as per the requirement of absorber) through 325 mesh Near Guaranteed Wear Part Life.			
5.04.02	In addition to the base offer described above, the bidder may also give an alternate offer for 2x100% tube mills with each mill sized to meet 110% of the maximum limestone requirement of all the three units operating simultaneously at 100% BMCR, with Design/Worst/Best Coal (whichever gives the maximum limestone requirement). All other stipulations with respect to sizing and design of mill, auxiliaries and other systems shall be in line with this specification. Bidder shall indicate the applicable rebate for such an alternate offer in the relevant attachment of the schedules. The bidder shall furnish details of the previous installations of such system and the complete technical details, effect on guarantees and the commercial implications for the Employer to assess the suitability of the alternative. Bidder shall furnish guarantee schedules for alternate offer separately as per format enclosed in BPS. The alternate offer shall also include mandatory spares for all the items and their corresponding quantities as specified in the Technical Specification.			
5.04.03	All integral auxiliaries of the mills like hydro-cyclones, separator tank & mill circuit pumps shall be sized to meet the above conditions. A 100% stand-by pump shall be provided for the mill circuit pump.			
5.04.04	The mill hydro-cyclone set shall have sufficient redundancy. A minimum 10% spare hydro-cyclone shall be provided in each set of hydro-cyclone. The hydro-cyclone s shall be designed to meet the requirements stipulated in CI11.00.00 of this Sub-Section.			
5.04.05	All parts of the mill including mill body, trunnion, hydro-cyclones, integral pipes, mill circuit pumps and other parts in contact with limestone slurry shall be provided with replaceable rubber wear liners. The wear liners or wear parts shall have a minimum guaranteed wear life of not less than 14000 hrs without reversal of the liners. The guaranteed capacity and fineness of the mill shall not be affected within the guaranteed life of the mil wear parts.			
5.04.06	The material of the balls shall be chosen to ensure that the balls do not lose their original shape and to ensure minimum ball consumption. The contractor shall also guarantee ball consumption per ton of limestone throughput. The contractor shall furnish the minimum ball diameter below which the balls shall be replaced.			
5.04.07	Facility shall be provided for on-load loading of steel balls to the mill.			
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5.04.08	The ball mill shall be driven by a motor through a peripheral gear. An auxiliary motor shall also be provided for inching of mills after trip and during maintenance.			
5.04.09	The lube oil system shall have 100% stand-by arrangement for lube oil pumps and oil coolers of each circuit with independent pump / cooler. Wherever required duplex oil filters shall be provided.			
5.04.10	The mill auxiliaries like separator tanks, mill circuit pump, hydro-cyclones and all connecting pipes handling limestone slurry shall have replaceable rubber linings.			
5.05.00	Limestone Slurry Preparation / Storage Tank			
5.05.01	The contractor shall provide two (2 nos.) slurry storage tank, common for all mills. Each tank shall be sized to meet 2 hours continuous limestone requirement of all the three (3) units operating at 100% BMCR with Design/Worst/Best coal whichever gives the maximum limestone requirement. For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower.			
5.05.02	The storage tanks shall be equipped with sufficient number of agitators, to avoid settling of limestone, as per the proven practice of the supplier. The agitators shall be designed to meet the requirements stipulated in Cl. No. 11.00.00 of this Sub-Section.			
5.05.03	The slurry preparation tank shall be CS construction with replaceable rubber lining.			
5.06.00	Limestone Slurry Supply Pumps			
5.06.01	2x100% centrifugal type limestone slurry pump shall be provided for each unit. Each limestone slurry pump shall be sized to supply the limestone requirement of one (1 no.) unit, under the following conditions all occurring together. i. Load ii. Flow iii. Head iv. Margins v. Solids Concentration 100% BMCR 110% of one absorber requirement with the boiler firing DC/WC/BC whichever gives the maximum limestone requirement. As per system requirement. a. Flow 10% (minimum) b. Heads 15% (minimum) Max. 30% by weight or actual as per suppliers practice, whichever is minimum.			
5.06.02	The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No7.00.00 of this Sub-Section.			
5.06.03	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. The slurry pipes shall be lined with replaceable rubber lining.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.00.00	GYPSUM DEWATERING SYSTEM			
6.01.00	A common gypsum dewatering system for all the units is envisaged for the station. Contractor shall supply a two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum from absorber upto less than 10% moisture. All the equipments supplied shall be proven design with previous installations for similar capacities.			
6.01.01	In addition to the base offer described above, the bidder may also give an alternate offer for 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the three units operating simultaneously at 100% BMCR, with any coal from the specified range of coals (whichever gives the maximum gypsum flow). All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification. Bidder shall indicate the applicable rebate for such an alternate offer in the relevant attachment of the schedules. The bidder shall also furnish details of the previous installations of such system and the complete technical details of effect on guarantees and the commercial implications for the Employer to assess the suitability of the alternative. Bidder shall furnish guarantee schedules for alternate offer separately as per format enclosed in BPS. The alternate offer shall also include mandatory spares for all the items and their corresponding quantities as specified in the Technical Specification.			
6.02.00	Primary Dewatering Hydro-cyclones			
6.02.01	Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by one unit operating at 100% BMCR with any coal from the specified range of coals (whichever gives the maximum gypsum production) with an additional 10% margin. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters.			
6.02.02	Each set of primary hydro-cyclone shall be provided with minimum 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service.			
6.02.03	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water sump. The hydro-cyclones shall be designed to meet the requirements stipulated in Cl. No11.00.00 of this Sub-Section.			
6.03.00	Vacuum Belt Filters			
6.03.01	Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: i. Gypsum Quantity 110% of gypsum produced by one Absorber with the Boiler operating at BMCR with any coal from the specified range of coals, whichever gives the maximum gypsum flow.			
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	ii. Outlet Moisture 10% max. iii. Gypsum Purity 90% (minimum)			
6.03.02	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.			
6.03.03	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design.			
6.03.04	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.			
6.03.05	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.			
6.03.06	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.			
6.03.07	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided.			
6.03.08	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.			
6.03.09	Gypsum cake from each belt filter shall be discharged through a hopper onto employer's common belt conveyor.			
6.03.10	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. Handling facilities for replacement of heavy components of the belt shall also be provided.			
6.04.00	Vacuum System			
6.04.01	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice.			
6.04.02	Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional margin of 10% (min.) over the above capacity shall be provided for each vacuum pump.			
6.04.03	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitations under all operating conditions. The seals shall be of proven design.			
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6.04.04	Silencers shall be provided, if required, to limit the noise level to values stipulated in Chapter-..... Part-..... of the specification.			
6.04.05	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application.			
6.04.06	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.			
6.05.00	Filtrate System			
6.05.01	Water from vacuum receiver tank(s) and the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks.			
6.05.02	2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. 2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter. Alternatively, wash water pump may take suction from the vacuums receiver tanks. Each pump shall be provided with 100% standby in such a case.			
6.05.03	The pump shall be capable of pumping of filtrate water with solid concentration of not less than 10% & particle lumps of 6-7mm. A 10% margin shall be provided in each of the pump.			
6.06.00	Waste Water System			
6.06.01	The overflow of the primary hydro-cyclones shall be taken to a hydro-cyclone waste water tank for feeding the secondary waste water hydro-cyclones.			
6.06.02	The tank shall be sized to provide a minimum storage of 8 hrs. of primary hydro-cyclone overflow with all the units operating at MCR and no outflow from the tank.			
6.06.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary waste water hydro-cyclones. Each pump shall be sized to empty the full storage capacity of the tank in 6 hrs.			
6.06.04	Each set of hydro-cyclone shall be sized to process the maximum discharge from the feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set.			
6.06.05	The secondary waste water underflow shall be taken to the filtrate tank, while the overflow shall be taken to a waste water sump.			
6.06.06	Waste water tank shall be sized for 8 hrs. storage of waste water with all the units operating at MCR and no out flow from the tank. 2x100% horizontal centrifugal pumps shall be provided for discharge of waste water at to employer's terminal point. All piping upto the employer's terminal point shall be in the contractor's scope. Provision to correct the pH of the waste water by lime dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once desired pH is achieved. A pH monitor shall be provided at the discharge of the pumps for measurement and control.			
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6.06.07	Lime tank for neutralization shall be of 2 Cum capacity in carbon steel construction with epoxy painting. The tank shall be provided with SS dissolving basket, agitator of SS construction, drain, overflow and dosing connection.			
6.06.08	The waste water collection tank shall be of Steel construction with epoxy painting. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water to ash slurry sump. The material of Casing and impeller shall be rubber lined Cast Iron (IS:210 Gr FG260). Shaft and Shaft Sleeves shall be Stainless Steel-410.			
6.06.09	Auxiliary Absorbent Sump			
6.07.00	The employer shall provide an auxiliary absorbent sump, common for the three units, sized to contain the complete slurry of one absorber tank at its maximum level.			
6.08.00	The contractor shall provide 2x100% Slurry sump pumps to pump back the slurry from the sump back to any of the absorbers in a maximum time of 12 hours.			
6.09.00	Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down. There shall be at least one redundant agitator for this purpose.			
7.00.00	SLURRY PUMPS			
7.01.00	This Clause covers the design, manufacture and erection of all slurry pumps for the FGD system including the Absorber slurry recirculation pumps, Gypsum bleed pumps, Limestone feed pumps, Pulverizer separator recirculation pump and any other pump handling slurries.			
7.01.01	The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.			
7.01.02	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head with margins as specified in the respective clauses. The slurry concentration in the pump shall not exceed 30% by weight.			
7.01.03	All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken form the process water supply			
7.01.04	The pump casing should be radially split to allow easy removal of impeller.			
7.01.05	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The contractor can also offer an alloy line pump if he has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.			
7.01.06	For absorber recirculation service a Silicon carbide impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
7.01.07	The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than14000 hrs.		
7.01.08	The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft.		
7.01.09	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.		
8.00.00	VERTICAL SUMP PUMPS		
8.01.00	Employer shall provide sumps of adequate capacity in the each absorber area, limestone grinding area and gypsum dewatering area for containing the over flow from the respective systems. Contractor shall make arrangements for pumping the drainage water back to the respective system with vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump. Adequate redundancy in line with the standard practice adopted by the bidder shall be provided. This Clause covers the design, manufacture and erection of all vertical sump pumps for the FGD system.		
8.01.01	The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.		
8.01.02	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.		
8.01.03	The pump shall deliver the rated flow at rated head with margins as specified in the respective clauses. The pump shall be capable of pumping of water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.		
8.01.04	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.		
8.01.05	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.		
9.00.00	AGITATORS		
9.01.00	All slurry tanks and sumps shall be provided with mechanical agitators with adequate redundancy as specified in the respective clauses. The design of the agitators shall be of proven type.		
9.02.00	The shaft and blades of the agitators shall be of stainless steel or Nickel alloy suitable to the service condition. Alternatively, the blades can also be provided with rubber lining with a minimum life of 2 years.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 
10.00.00	SLURRY LINES AND VALVES
10.01.00	Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve for the above purpose.
10.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality.
10.03.00	The isolation valves provided in all the slurry lines shall be of knife gate type. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.
10.04.00	The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.
10.05.00	The isolation valves shall be of knife gate type with rubber seats designed to prevent accumulation of solids on the valve seat.
11.00.00	HYDRO-CYCLONES
11.01.00	Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
11.01.01	The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The feed chamber shall be provided with a minimum lining thickness of 25mm. The liners shall have a minimum wear life of not less than 7000 hrs.
12.00.00	PROCESS WATER STORAGE TANKS & PUMPS
12.01.00	Each process water storage tank shall be designed to store 15 minutes of total water required for the entire FGD process (including absorber and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system) for all the units. The tank shall be carbon steel construction and shall receive water supplied (as identified in Subsection titled "Terminal points" in Part-A of Technical Specification) by Employer. The Tanks shall be provided with drain, over flow & inlet level control valves etc.
12.02.00	Process water shall be pumped from these tanks. 3 x 50% (Two working & one standby) process water pumps shall be provided to cater to the water requirement of the entire FGD system of all the units. The capacity of the pumps shall be such that total capacity of working pumps shall meet the process water requirement of all the units operating simultaneously at maximum load.
12.03.00	3x50% pumps shall be provided for supplying water for the mist eliminator washing system of all the absorbers. The capacity of the pumps shall be such that the total capacity of working pumps is sufficient to meet the wash water requirements of mist eliminators of all the absorbers. A further 10% margin shall be provided over the above capacity.
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
12.04.00	The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc.			
13.00.00	APPROACH AND HANDLING FACILITIES			
13.01.00	Proper approach shall be provided for access to all equipments during normal operation and maintenance. Unless otherwise specified, platforms, staircase and ladders shall follow the stipulations in the civil section of this specification.			
13.02.00	Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with a minimum width of 1000 mm shall be provided for approach to elevated structures at above 5 m height from the nearest platform. Below this height a vertical ladder with a minimum clear width of 600 mm may also be acceptable.			
13.03.00	Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for access to the platform.			
13.04.00	The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation.			
13.05.00	A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided.			
13.06.00	Platform with a minimum width of 1500 mm shall be provided all around the pulverizers and feeders. Approach alongwith suitable platforms shall be provided for ball loading hoppers.			
13.07.00	A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone.			
13.08.00	A 2000 mm wide floor/platform shall be provided all around each belt filter.			
13.09.00	The contractor shall provide adequate handling facility with motorized hoist, runway beams etc. for handling / maintenance of heavy components. Motorized hoists shall be provided for handling of all components exceeding 500 kgs.			
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CLAUSE NO.	INTENT OF SPECIFICATION			
1.00.00	INTENT OF SPECIFICATION			
1.01.00	Scope of the Proposal The scope of the proposal for Engineering, Supply, Construction, Erection, Testing & Commissioning works of Steam Generator with ESP Package which includes flue gas desulphurization system also for Bongaigaon Thermal Power Project (3x250 MW) shall be on the basis of a single point responsibility, completely covering the following activities and services in respect of all the equipment specified and covered under the specifications and read in conjunction with "Scope of Supply & Services", Sub-section-III, Part-A, Section-VI of Technical Specification. (a) Detailed design of all the equipment and systems. (b) Providing engineering drawings, data, operation and maintenance manuals, etc. for the Employer's approval. (c) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required. (d) Complete manufacturing including shop testing/type test. (e) Packing and transportation from the manufacturer's works to the site including customs clearance/port clearance, port charges, if any. (f) Receipt, storage, preservation, handling and conservation of the equipment at the site. (g) Fabrication, preassembly, (if any), erection, testing, commissioning and completion of facilities including putting into satisfactory operation of all the equipments and successful completion of initial operation; (h) Reliability tests and guarantees tests after successful completion of facilities. (i) Furnishing of spares on FOR site basis. (j) Reconciliation with customs authorities, in case of Foreign Contractors. (k) Satisfactory completion of the contract.			
1.02.00	The work to be carried out as per the above scope shall be all in accordance with the requirements, conditions, appendices, etc., stated in Section GCC, which shall be considered as a part of the Technical Specification (Section-VIA) as completely as if bound herewith. The Contractor shall be responsible for providing all material, equipment and service, which are required to fulfill the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. It is not the intent to specify completely herein, all aspects of design and construction of equipment, nevertheless, the equipment shall conform in all aspects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the			
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CLAUSE NO.	INTENT OF SPECIFICATION 			
	Employer, who will interpret the meaning of the specification, drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable international standards mentioned elsewhere in this specification. Bidder is requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specification. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the Conditions of Contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Employer in writing before the award of this contract, based on a written request from the Bidder for such a clarification. However, if the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately. The Bidder may also make alternate offers, provided, such offers are superior in his opinion, to the requirements of these specifications in which case, adequate technical information, operating feed back, etc., are to be enclosed with the offer, to enable the Employer to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumption etc., shall be clearly brought out for the Employer to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications. Under no circumstances the specified equipment and services shall be brought out as an alternative offer. In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection. 1.03.00 The following are the equipments covered in this specification. 1.03.01 Three (3) numbers of coal fired Steam Generator units, each having a maximum continuous rating of 810 tonnes per hour of superheated steam, complete with all accessories and auxiliary equipments as per specification requirements. 1.03.02 Three (3) numbers of elevators, one serving one steam generator. 1.03.03 Three (3) numbers of elevators, one elevator serving ESP control room for one unit. 1.03.04 Three (3) sets of boiler external high pressure piping, valves, fittings and accessories, one set serving one steam generator. 1.03.05 Common Fuel Oil pressurizing and heating System and common LDO pressuring system for all boilers. 1.03.06 Common Fuel Oil and Light Oil storage system. Provision for new unloading System to be associated with existing storage system for all the Steam Generators and also for Light Diesel Oil. 1.03.07 Three (3) sets of Electrostatic Precipitators, one for each Steam Generator.			
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CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
1.03.08	Three (3) sets of Wet Limestone-Gypsum based Flue Gas Desulphurisation systems, one for each Steam Generator.			
1.03.09	Mill reject handling system.			
1.03.10	Associated Power Cycle Piping, LP Piping, Equipment Water Cooling System.			
1.03.11	One (1) Auxiliary Boiler			
1.03.12	Associated Electrical and Control & Instrumentation (C&I) equipments.			
1.04.00	Wherever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood to be descriptive only and not restrictive. Such description indicates the equipment type, function and quality desired. Other manufacturer's products may be considered provided sufficient information so as to enable the Employer to determine that the products proposed are equivalent to those named.			
2.00.00	APPLICABLE DRAWINGS The drawings listed below and forming part of the specification (Refer Part-E) shall supplement the requirements specified herein. The scope and terminal points of the equipment to be furnished under this steam generator package shall be as identified in these drawings and read in conjunction with text of the specification. (a) LAYOUT DRAWINGS (i) Vicinity Plan : Drg No. 4610-999-NOG-W-001 (ii) General Layout Plan : Drg No. 4610-999-POC-F-001 (iii) Main Plant Equipment Layout Plan at 0.00M : Drg No. 4610-999-POM-A-001 (iv) Equipment Layout Plan in A-B bay at El:8.5M, 13.5M : Drg No. 4610-999-POM-A-002 (v) Layout of B-C Bay : Drg No. 4610-999-POM-A-003 (vi) Main Plant Cross Section : Drg No. 4610-999-POM-A-004 (vii) Flue Gas Duct Terminal Point inside Chimney : Drg No. 4610-101-POC-A-001 (b) SCHEMES (i) Main steam, CRH, HRH and HP/LP Bypass system : Drg No. 4610-999-POM-A-005 (ii) Auxiliary Steam Steam P&ID : Drg No. 4610-999-POM-A-006			
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	(iii)	Extraction Steam System	:	Drg No. 4610-999-POM-A-007
	(iv)	Condensate System P&ID	:	Drg No. 4610-999-POM-A-008
	(v)	Feed Water P&ID	:	Drg No. 4610-999-POM-A-009
	(vi)	Steam drain system P&ID	:	Drg No. 4610-999-POM-A-011
	(vii)	Symbols & Legends	:	Drg No. 4610-999-POM-A-012
	(viii)	Fuel Oil System flow diagram	:	Drg No. 4610-101-POM-A-002
	(ix)	Air and Flue gas flow diagram (2 Sheets)	:	Drg No. 4610-101-POM-A-003
	(x)	Scheme for Pulveriser	:	Drg No. 4610-101-POM-A-005
	(xi)	Flue gas desulphurization sytem flow diagram (3 Sheets)	:	Drg No. 4610-101-POM-A-006
	(xii)	P&I diagram of Equipment Cooling Water System (Unit Auxiliaries)	:	Drg No. 4610-999-POM-A-022
	(xiii)	Compressed Air System	:	Drg No. 4610-999-POM-A-023
	(c)	CONTROL & INSTRUMENTATION		
	(1)	DDCMIS configuration diagram	:	Drg. No. 4610-101-POI-A-001
	(2)	Burner management system configuration diagram (MFT subgroup) (2 Sheets)	:	Drg. No. 0000-999-POI-A-002
	(3)	DDCMIS Control System Functional Grouping Diagram	:	Drg. No. 4610-101-POI-A-009
	(4)	MMIPIS Configuration diagram alternative - 1	:	Drg. No. 4610-101-POI-A-011
	(5)	MMIPIS Configuration diagram alternative - 2	:	Drg. No. 4610-101-POI-A-012
	(6)	Confirmation Diagram for PLC Based Offsite Control System	:	Drg. No. 0000-999-POI-A-013
	(7)	Scheme for DC power supply system (2 sheets)	:	Drg. No. 0000-999-POI-A-019
	(8)	Instrumentation cabling philosophy (3 sheets)	:	Drg. No. 0000-999-POI-A-021
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	(9)	Instrument installation diagrams (13 sheets)	: Drg. No. 0000-999-POI-A-022 to 034	
	(10)	Instrument source connection diagrams (14 sheets)	: Drg. No. 0000-999-POI-A-035	
	(11)	Typical GA of Local Instrument Enclosures / racks (3 sheets)	: Drg. No. 0000-999-POI-A-064	
	(12)	Interfacing of Field Instruments	: Drg. No. 0000-999-POI-A-065	
	(d)	ELECTRICAL		
	(1)	Ladder type cable tray	: Drg. No. 0000-211-POE-A-001	
	(2)	Perforated type cable tray	: Drg. No. 0000-211-POE-A-002	
	(3)	C1 & C2 Channel, Cable Tray Support System	: Drg. No. 4610-211-POE-A-013	
	(4)	Typical Details of Cable Tray Support System	: Drg. No. 4610-211-POE-A-014	
	(5)	Typical Details of Cable Tray Support System	: Drg. No. 4610-211-POE-A-015	
	(6)	Cantilever Arms	: Drg. No. 4610-211-POE-A-016	
	(7)	Typical Details of Cable Tray Support System	: Drg. No. 4610-211-POE-A-017	
	(8)	Typical Details of Cable Tray Support System	: Drg. No. 4610-211-POE-A-018	
	(9)	Fixing of Channel in Trench Wall	: Drg. No. 4610-211-POE-A-019	
	(10)	Bracket Floor Plate Light Duty	: Drg. No. 4610-211-POE-A-020	
	(11)	Bracket Floor Plate Heavy Duty	: Drg. No. 4610-211-POE-A-021	
	(12)	Bracket C1 Channel Clamp Heavy Duty & Bracket C2 Channel	: Drg. No. 4610-211-POE-A-022	
	(13)	Bracket Right Angle & Bracket Right Angle Heavy Duty	: Drg. No. 4610-211-POE-A-023	
	(14)	Beam Clamp	: Drg. No. 4610-211-POE-A-024	
	(15)	Bracket C1 Channel Clamp	: Drg. No. 4610-211-POE-A-025	
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CLAUSE NO.	INTENT OF SPECIFICATION		एनटीपीसी NTPC																		
	(16) Bracket Beam Clamp : Drg. No. 4610-211-POE-A-026 (17) Interfacing of actuators : Drg. No. 0000-999-POI-A-063 (18) Typical section of cable tray arrangement in trestle : Drg. no. 0000-101-POE-A-001 Note : All the above drawings are indicative of Employers requirements to enable the Bidder to make a suitable offer. All variations / alternations shall be clearly brought out in the technical deviation schedule with implications, if any. Such variations may be acceptable, after assessment of its implication and shall be subjected to the Employer's approval. However, the pitching between the units and flexibility of operation and maintenance desired by the schemes and layouts shall be binding.																				
3.00.00	QUALIFYING REQUIREMENTS																				
3.01.00	Provenness criteria for critical equipment, auxiliaries, systems and bought out items: The bidder/ his sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, and systems and bought out items as per criteria stipulated below: (a) PA, ID & FD Fans, Coal Pulverisers, Raw coal feeders, Air pre-heaters, Mill Reject Handling System, ID Fan Motor, Auxiliary boiler and Gas to Gas Heat Exchanger, Wet Limestone Grinding Mills, Limestone Slurry Pumps for the Flue Gas Desulphurisation System offered by the bidder shall be only from such manufacturer(s) who has previous experience of manufacturing and supplying the respective equipment(s) of the type and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one(1) coal fired plant for a period not less than one(1) year as on the date of bid opening: Type and Rating for Qualification <table><tr><th>Name of Equipment</th><th>Type of Equipment</th><th>Equipment Rating</th></tr><tr><td>PA fans</td><td>Axial type</td><td>Flow : 91 M³/Sec (minimum) with Head : 1350 mm WC (minimum) at Fan Speed : 1500 rpm (maximum)</td></tr><tr><td>ID fans</td><td>Radial type</td><td>Flow : 232 M³/Sec (minimum) with Head : 702 mm WC (minimum) at Fan Speed : 600 rpm (maximum)</td></tr><tr><td>FD fans</td><td>Axial type</td><td>Flow : 99 M³/Sec (minimum) with Head : 487 mm WC (minimum) at Fan Speed : 1500 rpm (maximum)</td></tr><tr><td>Coal Pulveriser</td><td>Bowl mill/Roller mill /Ball & Race mill/ or approved equivalent</td><td>Capacity - 30 T/Hr (Min) with all following conditions together a. coal pulverizing fineness not less than 70% thru 200 mesh b. coal input size up to 50 mm c. Total moisture in raw coal- 10%</td></tr><tr><td>Raw Coal Feeders</td><td>Gravimetric, belt type</td><td>Capacity - Not less than 36 T/Hr with minimum size of 36"</td></tr></table>			Name of Equipment	Type of Equipment	Equipment Rating	PA fans	Axial type	Flow : 91 M ³ /Sec (minimum) with Head : 1350 mm WC (minimum) at Fan Speed : 1500 rpm (maximum)	ID fans	Radial type	Flow : 232 M ³ /Sec (minimum) with Head : 702 mm WC (minimum) at Fan Speed : 600 rpm (maximum)	FD fans	Axial type	Flow : 99 M ³ /Sec (minimum) with Head : 487 mm WC (minimum) at Fan Speed : 1500 rpm (maximum)	Coal Pulveriser	Bowl mill/Roller mill /Ball & Race mill/ or approved equivalent	Capacity - 30 T/Hr (Min) with all following conditions together a. coal pulverizing fineness not less than 70% thru 200 mesh b. coal input size up to 50 mm c. Total moisture in raw coal- 10%	Raw Coal Feeders	Gravimetric, belt type	Capacity - Not less than 36 T/Hr with minimum size of 36"
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3.01.01	Air pre heaters	Rotary regenerative (Lungstorm or approved equivalent) Tri sector type with vertical axis of rotation	Air pre-heater rating not less than that supplied for 210 MW or higher size unit.	
	Auxiliary Boiler	Water tube, oil fired.	50 tons/hour	
	Mill Reject Handling System	Pneumatic system	1 T/hr of coal rejects or higher capacity	
	ID Fan motor	Synchronous or Squirrel Cage Induction Motor	At least 2.0 MW	
	Wet Limestone Grinding Mill	Tube Mill or equivalent	Capacity – 10 T/hr (Min) with pulverizing fineness not less than 90% thru 325 mesh	
	Limestone Slurry Pumps	Centrifugal type	Minimum capacity of 40 T/hr at head atleast equivalent to the system resistance of the offered FGD system.	
	Gas to Gas Heat Exchanger	Rotary regenerative type with vertical axis of rotation Or with Heat Pipe type	Gas to Gas Heat exchanger rating not less than that supplied for a similar FGD application capable of handling flue gas flow equivalent to 200 MW or more.	
	Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified.			
	Provenness Criteria for other equipment			
	(a) Electrostatic Precipitator: The bidder/his sub-vendor should have designed, engineered, manufactured, erected/ supervised erection and commissioned/supervised commissioning of rigid discharge framework Electrostatic Precipitator having a design efficiency of not less than 99%, operating in conjunction with a pulverised coal fired steam generating unit, rated for a minimum of 200 MW unit size or equivalent steaming capacity, which is are in successful operation in at least one station for at least one (1) year as on the date of bid opening.			
(b) Wet Limestone based Flue Gas Desulphurisation system The bidder/his sub-vendor should have designed, engineered, manufactured, erected/ supervised erection and commissioned/supervised commissioning of atleast one(1) no. of Wet Limestone based Flue Gas Desulphurisation system having flue gas treatment capacity of not less than 800 T/hr, with design SO _x removal efficiency of atleast 85%, operating in a Pulverised Coal fired power plant in conjunction with Electrostatic Precipitator, which is in successful operation for atleast one (1) year as on the date of bid opening.				
(c) Power Cycle Piping: The bidder/ his sub-vendor should have designed, engineered (including static and dynamic analysis, hanger engineering, stress analysis.), fabricated/ got fabricated, supplied, erected/got erected power cycle piping systems including main steam, hot reheat, cold reheat, steam piping etc. for at least one fossil fuel fired thermal power unit of size 200 MW or above which is in successful operation for at least one (1) year as on date of bid opening.				
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 7 OF 9

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	AND SHOULD HAVE EXPERIENCE IN FABRICATION & WELDING OF MAIN STEAM PIPING WITH THE MATERIAL OF THE PIPE AS SPECIFIED AND OFFERED. (d) C & I Equipments/Systems: The bidder / his sub-vendor should have supplied: i) the Burner Management system (including Boiler Protection), the successful operation period shall be not less than one (1) year as on the date of Bid Opening in at least one unit of a coal fired power station having unit rating of 200 MW or above. ii) the Man-Machine Interface (MMI) system, the successful operation period shall be not less than one (1) year as on the date of Bid Opening in at least one (1) power station. iii) other parts of the SG C&I system of Distributed Digital Control, Monitoring & Information System (DDCMIS), which shall be in successful operation for a period not less than one (1) year as on the date of Bid Opening in at least one (1) unit of pulverized coal fired plant having unit rating of 200 MW or above. (e) Transformer Rectifier sets for Electrostatic Precipitator The offered TR sets shall be from a manufacturer who has past experience of manufacturing at least 70KV/1000 mA silicon filled TR sets which are in successful operation at a power plant (in ESPs for minimum 200 MW coal fired unit size) for a minimum one (1) year as on the date of bid opening.			
3.01.02	The bidder at his option can source the balance of plant/equipment/system not covered in Clause 3.01.00 & 3.01.01 above. However for such balance of plant/equipment /system, the Employer reserves the right to satisfy himself on the provenness of the equipment & capability & capacity of manufacturers.			
3.01.03	Agency for Erection & Commissioning Bidder / sub-vendor for erection and/or commissioning of the plant (to be engaged for this project) should have experience in erection and/or commissioning (as the case may be) of at least one (1) no. of coal fired reheat type of steam generator set of 200 MW or above capacity which is in successful operation for a period of not less than two (2) years as on the date of bid opening.			
3.01.04	To enable the approval of bidder and his sub-vendors, the bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/operation etc.			
3.01.05	Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the bidder / his collaborators / licensor / his sub-			
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	contractor to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 9 OF 9

CLAUSE NO.	PROJECT SYNOPSIS 			
1.00.00	BACKGROUND Details of proposed Stage / Units Project Name : Bongaigaon TPP No. of Units x capacity : 3 X 250 MW			
2.00.00	LOCATION AND APPROACH Project Location : (i) Place : Kumguri near Salakati Bongaigaon : (ii) District : Kokrajhar : (iii) State : Assam Latitude and Longitude of project location : North : 26° deg. 26' 21" East : 90° deg. 21' 0" Nearest Railway station : Salakati RS on Alipurduar-Bongaigaon section of North-East Frontier Railway at a distance of about 4 kms. Nearest Major Town : Bongaigaon at a distance of about 20 kms. from project site Nearest Commercial Airport : Guwahati at a distance of about 220 kms. Nearest Highway : National Highway (NH31)/ State Highway Distance from nearest highway point to the site : 25 KM / 7 KM Vicinity plan : Vicinity plan of the project enclosed at Annexure-I. Any other information : Further to the information given in this sub-section, Bidders are advised to visit the project site and collect data on local site conditions.			
3.00.00	LAND REQUIREMENT Total area of land for the project : 964 Acres Any other information : The existing plant and colony were built on 754 acres of land and the project is planned within the available land. For ash disposal, about 210 acres of land already exists at about 7 kms from the power plant			
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CLAUSE NO.	PROJECT SYNOPSIS 			
4.00.00	boundary. The project shall be accommodated within the existing premises of Bongaigaon TPS. WATER Nearest Water Source : The source of water for the existing station is Champamati river which has a perennial flow. 40 cusecs of water has been assured for the existing power station and raw water intake pump house has been constructed for drawal of water for the project. The water requirement for the project is proposed to be met from this river for which commitment of State Govt. is available. Proposed water requirement for the project : 40 Cusec Proposed arrangement to meet the Water requirement : The make up water requirement for this project would be about 3625 cubic m/hr with ash water recirculation system and about 3810 cubic m/hr. with once through ash water system. It is proposed to adopt re-circulating type CW system with Cooling Towers for the project.			
5.00.00	COAL LINKAGE / AVAILABILITY AND TRANSPORTATION (a) Coal Linkage / Availability Proposed source/arrangement : The coal for the main Steam Generator(s) shall be a blended coal from supplies from Makum Coal Fields of NECL and Non Ranigang Coal fields of ECL viz Mugma, Salanpur, SP mines and Rajmahal Coal Fields. The coals of NECL and ECL are likely to be blended in 58:42 ratio for this project. Coal GCV and PLF considered : 5000 (4500 to 5500) Kcal/kg for Assam Coal and 3400 (2900 to 3900) Kcal/kg for Coal from ECL. PLF of 90% has been considered for coal linkage. Coal Commitment/Coal Link : Coal linkage of 1.65 MTPA from North Eastern Coalfields and 1.2 MTPA of Coal from ECL mines would be made available.			
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	(b) Coal Transportation Existing coal transportation arrangement : The envisaged mode of coal transportation from the coal mines to the power plant is by Indian Railways network. Coal for the existing power station was earlier being received from ECL through Railway network upto Salakati Railway Station and then through railway siding connecting plant with Salakati RS. It is proposed to use the existing siding for receipt of ECL coal. Proposed Coal transportation arrangement : It is proposed to augment/construct additional siding to facilitate receipt of coal from North Eastern Coalfields (Assam coal) The envisaged mode of coal transportation from the coal mines to the power plant is by Indian Railways rakes in BOX-N wagons. Accordingly, provision of two numbers of Wagon Tippers have been kept in the present proposal. (c) Coal Quality Parameters and Fuel Oil Characteristics The Coal quality parameters and Fuel Oil Characteristics are enclosed at Table-1(A, B & C), Table 3 & Table-4 of Sub-Section-V, Salient Design Data, Part-A, Section-VI.			
6.00.00	LIMESTONE AVAILABILITY Proposed source/arrangement : The Limestone for the FGD system shall be sourced from Umrangshu mines of Assam Mineral Development Corporation Ltd.			
7.00.00	RAILWAY SIDING For bringing the equipment and material to the power house through rail, railway siding is existing from Salakati railway station upto the project.			
8.00.00	METEOROLOGICAL DATA Data of Bongaigaon station is enclosed as Annexure-I to this subsection.			
9.00.00	PLANT WATER SCHEME The Plant water scheme is described below:			
9.01.00	Condenser Cooling (CW) Water System It is proposed to provide recirculating type CW system with natural draft type cooling towers. For the re-circulating type CW system, it is proposed to supply clarified water as makeup. CW system shall be operated at a C.O.C. of about 2.5. The expected			
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	circulating water analysis is given in this sub-section. For carrying circulating water from CW pump house to TG area and from TG area to cooling tower, steel lined concrete encased duct with internal lining would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes with internal coating would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.			
9.02.00	Equipment Cooling Water (ECW) System (Unit & Station Auxiliaries) The plant auxiliaries of Steam Generator shall be cooled by Demineralised water (DM) in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system.			
10.00.00	ASH WATER SYSTEM (a) It is proposed to operate ash water system in a closed circuit. The ash water from the ash dyke shall be recirculated. During re-circulation mode, the make up to the ash water system (to compensate for the ash water blow down and evaporation loss in ash dyke) shall be supplied from plant make-up. (b) During initial stage when decanted ash water is not available, the ash water system shall be operated in once through mode and make up water to ash water system shall be given from plant make up. (c) Considering total ash handling plant water requirement of 600 Cu.M/hr. (excluding the water required for cooling of air compressors and vacuum pumps but inclusive of seal water of ash slurry pumps) during re-circulation mode operation, it is expected that about 455 M³/hr of decanted ash water shall return to the ash handling system after accounting for evaporation loss.			
11.00.00	OTHER MISCELLANEOUS WATER SYSTEMS (a) CW system blow down water shall be used for the dust suppression system of coal handling plant, ash slurry pumps sealing. Clarified water shall meet the other water requirements of the plant. The service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal. (b) The drinking water requirement of the plant and colony shall be provided from filtered water tank. (c) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant. The quality of Cooling Water, Raw Water, Clarified water, filtered (potable) water and DM water is given in the enclosed Annexure-II to this Sub-section.			
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	ANNEXURE -I		
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	ANNEXURE -II			
	WATER ANALYSIS			
	Sl.No.	Constituent	As	mg per litre
	(a)	COOLING WATER ANALYSIS		
	1.	Calcium	CaCO3	188
	2.	Magnesium	CaCO3	75
	3.	Sodium	CaCO3	37.5
	4.	Potassium	CaCO3	0
	5.	Total Cations	CaCO3	300.5
	6.	Chloride	CaCO3	55
	7.	Sulphate	CaCO3	81.25
	8.	Bicarbonates	CaCO3	164.25
	9.	Carbonates	CaCO3	0
	10.	Nitrates	CaCO3	0
	11.	Total Anions	CaCO3	300.5
	12.	Iron	Fe	0
	13.	Silica	SiO2	56
	14.	PH		8-8.3
	15.	Turbidity (Max)	NTU	25
	16	Organic Matter (Oxygen absorbed from acid Permanganate in 4 hrs)	Mg/l	0.3
	(b)	RAW WATER ANALYSIS		
	1.	Calcium	CaCO3	50
	2.	Magnesium	CaCO3	30
	3.	Sodium	CaCO3	15
	4.	Potassium	CaCO3	0
	5.	Total Cations	CaCO3	95
	6.	Chloride	CaCO3	15
	7.	Sulphate	CaCO3	10
	8.	Bicarbonates	CaCO3	70
	9.	Carbonates	CaCO3	0
	10.	Nitrates	CaCO3	0
	11.	Total Anions	CaCO3	95
12.	Iron	Fe	1.5	
13.	Silica	SiO2	14	
14.	PH		7.6-8.0	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-II PROJECT SYNOPSIS	PAGE 7 OF 10

CLAUSE NO.	PROJECT SYNOPSIS 			
	15.	Turbidity (Max)	NTU	500
	16.	Organic Matter (Oxygen absorbed from acid Permanganate in 4 hrs)	Mg/l	2
	(c)	CLARIFIED WATER ANALYSIS		
	1.	Calcium	CaCO ₃	75.2
	2.	Magnesium	CaCO ₃	30
	3.	Sodium	CaCO ₃	15
	4.	Potassium	CaCO ₃	0
	5.	Total Cations	CaCO ₃	120.2
	6.	Chloride	CaCO ₃	22
	7.	Sulphate	CaCO ₃	32.5
	8.	Bicarbonates	CaCO ₃	65.7
	9.	Carbonates	CaCO ₃	0
	10.	Nitrates	CaCO ₃	0
	11.	Total Anions	CaCO ₃	120.2
	12.	Iron	Fe	0
	13.	Silica	SiO ₂	14
	14.	PH		7.6-8.0
	15.	Turbidity (Max)	NTU	10
	16.	Organic Matter (Oxygen absorbed from acid Permanganate in 4 hrs)	Mg/l	0.3
	(d)	FILTERED WATER ANALYSIS (DRINKING WATER)		
	1.	Calcium	CaCO ₃	75.2
	2.	Magnesium	CaCO ₃	30
	3.	Sodium	CaCO ₃	15
	4.	Potassium	CaCO ₃	0
	5.	Total Cations	CaCO ₃	120.2
	6.	Chloride	CaCO ₃	22
	7.	Sulphate	CaCO ₃	32.5
	8.	Bicarbonates	CaCO ₃	65.7
	9.	Carbonates	CaCO ₃	0
	10.	Nitrates	CaCO ₃	0
	11.	Total Anions	CaCO ₃	120.2
	12.	Iron	Fe	0
	13.	Silica	SiO ₂	14
	14.	PH		7.6-8.2
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-II PROJECT SYNOPSIS
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CLAUSE NO.	PROJECT SYNOPSIS			
	15.	Turbidity (Max)	NTU	2
	16.	Total dissolved solids		133.817
	17.	Organic Matter	(KMnO ₄ no.)	0.3
	18.	Temperature	Degree Celcius	20-32 oC
	ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER			
	Sl.No.	Characteristics	Value	
	1.	Silica (Max.)	0.02 ppm as SiO ₂	
	2.	Iron as Fe	Nil	
	3.	Total hardness	Nil	
	4.	pH value	6.8 to 7.2	
5.	Conductivity	Not more than 0.1 µmhos/cm Excluding the effects of free CO ₂		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	BASIC DESIGN CRITERIA			
1.00.00	GENERAL REQUIREMENTS			
1.01.00	The Contractor shall provide Independent SG Control & Instrumentation system, which is Distributed Digital Control, Monitoring and Information System (DDCMIS) based, associated Primary and Secondary Instruments, Panels, LIE/LIRs, Control Valves and Actuators, Process Connection and Piping, Electric Power Supply System, Electrical Actuators, Plant performance Analysis, Diagnosis & Optimisation System (PADO),associated Instrumentation Cables etc. as identified in the specification.			
1.02.00	The Contractor shall provide all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. This work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force.			
1.03.00	Further Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the Bidder and for meeting the intent and requirements of the specification.			
1.04.00	It is to be noted that where equipment or system for the generating units are described, it shall be understood that the quantities described are to be provided per unit basis, i.e., identical sets to be furnished by the Contractor for each of the units unless specifically indicated otherwise. Where equipment or systems for plant common facilities are described, it will be understood that the quantities described are the total quantities required. Wherever quantity has been specified as on as required basis, the same is to be supplied by the contractor on as required basis by the contractor within his quoted lump sum price.			
1.05.00	Bidder shall include in his bid a detailed Bill of Material (BOM) for each of the systems.			
1.06.00	In addition to requirements specified under this Section-VI, Part-B, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.			
2.00.00	PROVENNESS CRITERIA			
2.01.00	Provenness of Supplier: The various C&I equipment shall be from established sources i.e. The supplier for any particular type of equipment/system should have equipment /system manufactured by him and under successful operation in a Power Plant for not less than 2 years.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.01.01	Provenness of offered system: Equipment, system, instrument being offered by the bidder comprising of SG C&I System and their MMI system and other associated systems shall be as elaborated in Sub-Section-I, Part-A, Section-VI of Technical Specifications.			
3.00.00	RELIABILITY AND AVAILABILITY			
3.01.00	Each component and system offered by the Bidder shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Bidder, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete C&I system is assured for 99.7%.			
3.02.00	The Bidder shall submit detailed reliability calculations for each system/equipment which (with the help of a schematic of various sub-system connected in series or in parallel as the case may be and MTBF & MTTR values for the various equipments) shall show that availability calculation is as per IEEE Standard - P 1046 or equivalent. Bidder shall submit this along with bid.			
3.03.00	When more than one device uses the same measurement or control signal, the transmitter and other components/ module shall be fully equipped to provide all signal requirements. All the 4-20 mA output signals from transmitters/other control system shall be able to drive minimum 500 Ohms load resistance. The system shall be arranged 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.			
3.04.00	To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criteria mentioned above. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.			
4.00.00	STANDARDISATION AND UNIFORMITY OF HARDWARE			
4.01.00	To ensure smooth and optimal maintenance easy interchangeability and efficient spare parts management of various C&I instruments/equipment like all 4-20mA electronic transmitters/ transducers, control hardware, control valves, actuators and other instruments/ local devices etc. being furnished by the Bidder for main plant areas and other plant and station auxiliaries for similar applications, the Bidder shall ensure that they are of the same make, series and family of hardware.			
5.00.00	OPERABILITY & MAINTAINABILITY			
5.01.00	The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimised.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
5.02.00	The types of failure that shall be taken into account for ensuring operability of the plant shall include but not be limited to: — Failure of sensor or transmitter. — Failure of main and/or redundant controller/other modules. — Loss of motive power to final control element. — Loss of control power. — Loss of instrument air.			
5.03.00	The choice of hardware shall also take into account sound maintainability principles and techniques. The same shall include but shall not be limited to the following: — Standardization of parts. — Minimum use of special tools. — Grouping of functions. — Interchangeability. — Malfunction identification facility/self surveillance facility. — Easy modular replacement. — Fool proof design providing proper identification and other features to preclude improper mounting and installation. — Appropriate de-rating of electronic components and parts.			
5.04.00	The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.			
6.00.00	UNIT CONTROL & MONITORING PHILOSOPHY			
6.01.00	The Control & Monitoring philosophy envisages control from two locations (a.) From Central Control Room (CCR) (b.) From Local control stations for off site & ancillary plants			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC	
6.02.00	Back-Up Instrumentation Minimum back up of instrumentation to be provided by Employer as specified in Appendix-I to SG C&I and Contractor shall provide hardware of I/O modules for the same .					
7.00.00	ENVIRONMENTAL CONDITIONS					
7.01.00	Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.					
	Ambient Temperature (outside cabinets)	Pressure	Relative humidity	Atmosphere	Required protection Class of panels/ cabinets/ desks to be provided by contractor.	
	Outdoor Location					
	55 degree C max.	Atmosphere	100 % Max.	Air (dirty)	IP 55	
	4 degree C min.	Atmosphere	5 % min.	Air (dirty)	IP 55	
	Indoor Location					
	55 degree C max.	Atmosphere	95 % Max.	Air	IP 54**	
	4 degree C min.	Atmosphere	5 % min.	Air	IP 54**	
	Air Conditioned Areas					
	24 +/- 5 degree C normal	Atmosphere	95 % Max.	Air	IP 22***	
	50 degree C max. *	Atmosphere	5 %min.	Air	IP 22***	
	* During air conditioning failure.					
	** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42.					
	***With a suitable canopy at the top to prevent ingress of dripping water.					
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00	For hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location.			
	PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg.C. For LVS, maximum temperature limit shall be 25 Deg.C and for mini-UPS, the same shall be 40 Deg.C. GROUNDING SYSTEM All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable). Shield on instrumentation cables shall be grounded on panel side. When shielding termination is required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground. System and shield ground shall be connected to Employer provided earthing strip at 0.0 meter level using suitable size of cable to be provided by the Employer. Bidder shall refer Drawing. no. 4610-101-POI-A-021. The Contractor shall submit with the offer recommended grounding scheme required for his system. The exact grounding scheme shall be finalised during detailed engineering.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-01 BASIC DESIGN CRITERIA	PAGE 5 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	CONTROL VALVES, ACTUATORS & ACCESSORIES 1.00.00 CONTROL VALVES, ACTUATORS & ACCESSORIES 1.01.00 General Requirements 1.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the “Federal Occupational Safety and Health Standards, USA” or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification. 1.01.02 All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves. 1.01.03 This specification does not cover special type of control valves such as combined pressure and temperature control valve for Aux PRDS applications etc. 1.02.00 CONTROL VALVE SIZING & CONSTRUCTION 1.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes. 1.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer’s approval during detailed engineering. 1.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV-I-08 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 1 OF 6	

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1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV.			
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.			
2.00.00	VALVE CONSTRUCTION			
2.01.00	All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.			
2.02.00	Valves with high lift cage guided plugs & quick-change trims shall be supplied.			
2.03.00	Cast Iron valves are not acceptable.			
2.04.00	Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.			
2.05.00	Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.			
2.06.00	All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)			
2.07.00	Valve characteristic shall match with the process characteristics.			
2.08.00	Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.			
2.09.00	Flanged valves shall be rated at no less then ANSI press class of 300 lbs.			
3.00.00	VALVE MATERIALS			
	Sr. No.	Service	Body material	Trim Material
	1	Non-corrosive, non-flashing	Carbon steel ASTM-A216 Gr. WCB for fluid temperature below 275 Deg. C	316SS stellited with stellited faced guide posts and bushings.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	and non-cavitation service	Alloy steel ASTM-A217Gr. WC9 for fluid temperature above 275 Deg. C		
2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. 440 C WC9		
3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. 17-4 PH SS WC6		
4.	Condensate, DM water service	316 SS	316 SS	
NOTE Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34. However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.				
4.00.00	END PREPARATION Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.			
5.00.00	VALVE ACTUATORS All control valves shall be furnished with pneumatic actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified. The travel time of the pneumatic actuators shall not exceed 10 seconds.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.00.00	CONTROL VALVE ACCESSORY DEVICES		
6.01.00	All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.		
7.00.00	SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER		
	Electrical	Input Signal	4-20 mA
		Power Supply	Loop Powered from the output card of Control System.
		Hart Protocol	Compatibility For Remote Calibration & Diagnostics(Super-Imposed Hart Signal On Input Signal(4-20 mA)
		Valve Position Sensing	Position Sensing (Non Contact-Type),4-20 Ma O/P Signal For Control System To Be Provided
	Environment	Operating Temp	(-)30 To 80 Deg. C
		Humidity	0-95 %
		Protection Class	IP-65 Minimum
	Software For Configuration And Diagnostic	Software	Windows Based Software. Software Shall Meet the Requirement For Configuration, Diagnostics, Calibration And Testing Of The Actuator
		Diagnostic/Test Features	Advanced Diagnostic Features Like Stroke Counter Or Travel Counter, Leakage In Actuators, On Line Partial Closure Test, Valve Signature Analysis, Step Response Test, Valve Friction /Jamming Detection Etc To Be Provided
		Factory Valve Signature Tests Reports (Pr Vs Valve Travel And Travel Vs I/P Signal) are to be provided.	
	Hardware	PC	For Configuration/Software Ref PC Specified Under DDCMIS Section
	Tests Certificates	Test certificates as per Manufacture Standard/Relevant Standard are To Be Submitted	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Configuration/	Remote Calibration, Auto & Manual Calibration Shall Be Possible		
	Operating	Operating Range	Full Range & Split Range Signal Range	
	Modes	Valve Action	Direct & Reverse. Valve Action	
		Flow Characterization	Possible To Fit Valve Characteristic Curve Linear & Equal Percentage	
	Fail Safe/Fail Freeze	Fail Safe/Fail Freeze Feature is to Be Provided.		
	Pneumatic	Air Capacity	Sufficient To Handle The Valves Selected/Boosters To Be Supplied If Required.	
		Air Supply Pressure	To Suit The Air Supply Pressure/Quality Available.	
		Process Connection	1/4 Inch NPT	
	Performance	Characteristic Deviation	<=0.5 % Of Span	
		Ambient Temp Effect	<=0.01 %/Deg C Or Better	
	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent	
	Accessories	In Built Operator Panel	Display With Push Buttons For Configuration And Display On The Positioner Itself (Password Protected/Hardware Lock)	
		Hand Held Hart Calibrator	Universal Hart Calibrator To Be Provided, One Per Unit	
		Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As On Required Basis For Making System Complete.	
		Electrical Cable Entry	1/2-Npt,Side Or Bottom Entry To Avoid Water Ingress	
	Valves Mounting Assembly	For Sliding Stem/Rotary/Single Acting/Double Acting On Required Basis		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
8.00.00	TEST AND EXAMINATION All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following: 8.01.00 Non Destructive Test as per ANSI B-16.34. 8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test. 8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above. 8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position. 8.05.00 CV Test: CV test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be furnished for Employer's approval.			
9.00.00	CONTROL VALVE QUANTITIES Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS			
1.00.00	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES			
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at IIIC, Part-A, Section VI.			
1.02.00	The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID. Also refer item MEASURING INSTRUMENTS, Subsection CONTROL & INST, Part A, Section VI.			
1.03.00	All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-section: MEAS INST Part-B, Section VI. In addition, all electrical instrument devices like switches/transmitters/controllers/analysers/solenoid valves which are located in the field/hazardous locations like hydrogen generation plant shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All field wiring should be through conduits. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.			
1.04.00	Contractor shall provide independent control systems for safe, efficient and reliable operation of the plant auxiliary systems. The type of control system shall be as indicated under scope part at IIIC, Part-A, Section VI.			
1.05.00	ON/OFF control, indication, annunciation of incomers and bus-coupler are also to be performed from Contractor's Control System for each of the above system as applicable.			
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller modules without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules shall in no way jeopardize safety of plant and personnel.			
1.07.00	The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-09 AUX. PLANT CONTROL SYSTEM	PAGE 1 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault, failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as colour change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.			
1.08.00	The Control system shall operate in non-air conditioned area and shall meet the minimum requirements as specified below. The Contractor shall, however, provide a Package AC for his control system his Control system. The Control system shall meet the minimum requirements as specified below.			
1.09.00	Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-999-POI-A-013.			
2.00.00	PROGRAMMABLE LOGIC BASED CONTROL SYSTEM			
2.01.00	PLC PROCESSOR The processor unit shall be capable of executing the following functions:- - a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. - b Implementing all logic functions for control, protection and annunciation of the equipment and systems. - c Implementing modulating control function for certain application as specified elsewhere in the specification. - d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. - e Performing self-monitoring and diagnostic functions.			
2.02.00	Wherever Dual processor based PLC system has been specified, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group.			
2.03.00	The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.			
2.04.00	Priority of different commands shall be as follows:			
2.04.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.			
2.04.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.			
2.05.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS) PC based OWS (Operator Work Station) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface System. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided. Refer Subsection II C, Part A, and Section VI for exact number of Operator Workstations to be provided for each of the control systems. Specification of PC is provided below. 2.05.01 All OWS of the HMIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area on drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files. Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS. 2.05.02 All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions. 2.05.03 The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	for smooth operation, control & management of information as finalized during detailed engineering.			
2.05.04	The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.			
2.05.05	The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator).			
	When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.			
2.06.00	PROGRAMMING FUNCTIONALITIES			
	Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language. For example, the programming of PLC shall use either of the following:-			
	Flow-chart or block logic representing the instructions graphically.			
	Ladder diagrams.			
	The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.			
	All programming functionalities shall be password protected to avoid unauthorized modification.			
2.07.00	SOFTWARE REQUIREMENT			
	All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification. Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface. All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum. All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided. The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.			
3.00.00	INPUT/OUTPUT MODULES			
3.01.00	The PLC system should be designed according to the location of the input/output cabinets as specified.			
3.02.00	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, RTD, Thermocouple, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays, 4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing nos. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/Drives.			
3.03.00	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.			
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.			
3.05.00	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.			
3.06.00	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.			
3.07.00	The Contractor shall provide the following monitoring features: - a Power supply monitoring. - b Contact bounce filtering. - c Optical isolation between input and output signals with the internal circuits - d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering.			
3.08.00	Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog output modules shall be able to drive an load impedance of 500 Ohms minimum.			
3.09.00	Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.			
3.10.00	Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required, shall be done by the contractor in PLC system.			
3.11.00	All input field interrogation voltage shall be 24V DC or 48 V DC.			
3.12.00	In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper alarm/message.			
3.13.00	Wiring Scheme for inputs to control system shall be as follows:			
3.13.01	Each of the triple redundant binary & analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.			
3.13.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:			
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3.13.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.																					
3.13.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.																					
3.14.00	Binary & analog outputs shall be non-redundant only. Failure of any single module shall not affect operation of more than one single drive.																					
3.15.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.																					
3.16.00	The maximum number of inputs/outputs to be connected to each type of module shall be as follows: <table><tr><td>1</td><td>: Analog input module</td><td>16</td></tr><tr><td>2</td><td>: Analog output module</td><td>16</td></tr><tr><td>3</td><td>: Binary input module</td><td>32</td></tr><tr><td>4</td><td>: Binary output module</td><td>32</td></tr><tr><td>5</td><td>: Analog input & output (combined)</td><td>16</td></tr><tr><td>6</td><td>: Binary input and output (combined)</td><td>32</td></tr></table> Note: For binary inputs, one changeover contact is counted as 2 inputs.				1	: Analog input module	16	2	: Analog output module	16	3	: Binary input module	32	4	: Binary output module	32	5	: Analog input & output (combined)	16	6	: Binary input and output (combined)	32
1	: Analog input module	16																				
2	: Analog output module	16																				
3	: Binary input module	32																				
4	: Binary output module	32																				
5	: Analog input & output (combined)	16																				
6	: Binary input and output (combined)	32																				
3.16.01	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station CRTs for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the CRTs.																					
3.17.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 600 meters from the Central PLC, fiber optic data link has to be provided.																					
4.00.00	SYSTEM SPARE CAPACITY																					
4.01.01	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have																					
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	spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:			
4.01.02	10% spare channels in input/output modules fully wired up to cabinets TB.			
4.01.03	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.			
4.01.04	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.			
4.01.05	The Data communication system shall have the capacity to handle the additions mentioned above.			
4.01.06	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.			
4.01.07	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.			
5.00.00	DATA COMMUNICATION SYSTEM (DCS)			
5.01.00	The Data Communication System shall include a redundant Main System Bus with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant. The DCS shall have the following minimum features : - a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station. - b The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module			
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	connected to the system bus shall not result in loss of any communication function to and from any other station/module. - c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility. - d Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged. - e The design and installation of the system bus shall take care of the environmental conditions as applicable. - f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion. - g Passive coaxial cables or fiber optic cables shall be employed. The Contractor shall furnish details regarding the communication system like communication protocol, bus utilization calculations etc. 5.02.00 The PLC system shall be provided with necessary interface hardware and software for dual fiber optic connectivity & interconnection with station wide LAN (In Employer's Scope) for two - way transfer of signals for the purpose of information sharing. The plant information shall be made available through an Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engineering. All required plant data shall be transferred to/from through this ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering. The Contractor shall provide all assistance to the BOP C&I System (In Employer's Scope) Supplier including co-ordination and flow of required information etc. for display of all input points under alarm, connected to PLC or generated by PLC, on various operating stations on BOP C&I System (In Employer's Scope) and various client PCs on station LAN. 6.00.00 SYSTEM REACTION TIME 6.01.00 The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.			
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7.00.00 7.01.01 7.01.02 7.01.03 7.01.04 7.01.05 8.00.00 8.01.00	OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalized during detailed Engineering Stage. Historical storage and retrieval system (HSRS) The HSRS shall collect store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data. The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports. The data/information to be stored & frequency of storage and retrieval shall be as finalized during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk. In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based on various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of X-T display, X-Y display, logs, reports, etc. The system shall have provision of generation. Of reports and logs. General only two types of logs shall be. Reports and Logs:- The system shall have provision of generation of reports and logs. Generally two types of logs shall be provided. i) Time dependent - Periodically generated (shift log, daily log etc.). ii) Event dependent - Provision of thirty logs/reports of each type shall be provided. CONTROL & POWER SUPPLY SCHEME For PLC system, redundant 24 V DC power supply shall be provided by the contractor. Necessary redundant transformers and redundant chargers with 24 V DC battery back-up shall be provided by the Contractor to derive power supply from 415 V, 3-phase 3-wire incomers to be arranged by the Contractor at the input terminals			
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	of Power supply cabinets. The Contractor shall, however, furnish all required hardware/ equipment/ cubicles for conversion and/or stabilization of the power source provided by the Owner to all other levels which may be necessary for meeting the individual requirements of equipments/ systems furnished by him within the Contractor's quoted lump sum price. For separately mounted I/O racks, separate power supplies shall be provided. Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. All the drives shall be switched ON/OFF through 24V DC coupling relays to be provided in HT/LT SWGR panels. Power supply distribution from Contractor's power supply cabinets shall be in the scope of Contractor. The exact power supply scheme shall be as approved by Employer during detailed Engineering stage.			
8.02.00	The battery shall be Ni-Cd type batteries with long life and shall be able to provide a back-up for one hour at full load requirement of the complete control system.			
8.03.00	For remote I/O cabinets, micro PLC etc, separate redundant power supplies, suitable for 415V, 3-phase 3-wire incomers shall be provided. The equipment of power supply unit can be mounted as an integral part of the enclosure and the same shall provide all voltages necessary to power the processor and I/O modules. All required redundant power packs etc. with inbuilt chargers, with minimum thirty minutes battery back-up shall be provided .Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. However, the exact power supply scheme shall be as approved by Employer during detailed Engineering stage.			
9.00.00	CONTROL CABINETS / PANELS / DESKS			
9.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-basic Design criteria (Part-B, Section-VI) and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.			
9.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.			
9.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear			
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	doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.			
9.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.			
9.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalized during detailed engineering. (b.) Interior:- Same as above. Paint films which show sags, checks or other imperfections shall not be acceptable. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable. The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory painted surfaces of each item of equipment. The touch-up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.			
9.01.05	Refer Subsection Basic Design Criteria, Part B, Section VI for grounding requirements.			
9.02.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.			
9.03.00	Control Desk			
9.03.01	PC based OWS (operator Work Station) of PLC shall be mounted on table type control desk to house PC/ keyboards/ mouse etc. Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 34 mm thick wooden top shall be provided on the desk with proper finish of acrylic PVC/polyurethane paint. All operators work stations shall be			
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	mounted on this Control Desk. Employer supplied PA system hand sets, telephone sets and CCTV monitors shall also be mounted. Very few A/M Stations & PB stations and lamps may also be mounted on the control desk if found necessary. The Keyboard shall be capable of being pulled out through a tray. The desk shall be arranged in an continuous arc shape. The exact profile of the desk, dimension and the radius of curvature shall be finalized during detailed engineering stage.			
9.03.02	To achieve durable & water resistant finish, a coat of "Polyuthesive crystal clear" on the surface of unit control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of Control Desk should be in line with relevant International standards.			
9.03.03	Two nos. industrial grade chairs will be provided with control desk.			
10.00.00	ANNUNCIATION SYSTEM			
10.01.00	Only OWS based alarm system shall be provided with audio alarm facility (beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided.			
10.02.00	The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalized during detailed engineering. The alarm display/report format shall be as approved by the Employer.			
10.03.00	Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation per OWS shall be provided.			
10.04.00	At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels only on a per OWS basis.			
10.05.00	Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be for each process area & each priority therein.			
10.06.00	The annunciator sequence shall conform to ISA sequence ISA-2A.			
10.07.00	Annunciation facia windows are to be provided in local control panels where ever specified. The number of annunciation facia windows and the provision for original input will be on as required basis.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.08.00	SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS			
10.08.01	All technical manuals, reference manuals, user’s guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalisation for Employer’s review and approval.			
10.08.02	All The software listings including Source code for application software, All special-to-project data files etc. shall be submitted by the Contractor:			
10.09.00	SOFTWARE LICENCES			
	The Contractor shall provide software license for all software being used in Contractor’s System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor’s System at site. All licenses shall be valid for the continuous service life of the plant.			
10.10.00	Software Upgrades			
	As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.			
11.00.00	SPECIFICATIONS OF OPERATOR WORK STATION			
	The minimum requirement for PC based OWS shall be as below:			
	CPU	Latest generation CPU		
	Main memory	512 MB expandable to 1 GB		
	Drives	3 1/2" floppy drive, 48 x CD ROM drive		
	Hard disk	40 GB		
	Removable bulk storage drive (MOD / DVD / DAT)	6 GB (minimum)		
	Removable Bulk Storage Media	for 10 nos. above		
	Monitor	19" Full Flat TFT Resolution 1280 x 1024, refresh rate min 85 Hz.		
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	Graphic Memory 16 MB Communication port 2 serial plus, one parallel, 1 USB port, Dual 100 Mbps Ethernet. Expansion slots 3 Other Features 101 Keys Keyboard and Optical Mouse UPS 1 no. on-line Intelligent UPS with 30 mins. Battery backup on machine load (for PC & its printer) and remote monitoring are to be provided for each PC and PC based OWS. Software - a General MS Windows latest version, MS-Office, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc. - b Application software - to suit project specific requirement	
12.00.00	PRINTER Printer shall be provided as a part of the HMIS system.	
13.00.00	TRAINING Contractor shall provide training on PLC systems for Employee personnel. The exact duration of the training shall be as per Part-C, Section-VI.	
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	TYPE TEST REQUIREMENTS			
1.00.00	TYPE TEST REQUIREMENTS			
1.01.00	General Requirements			
1.01.01	The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening. (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.			
1.01.02	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.			
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.			
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different			
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1.01.05	parameters, interval of recording precautions to be taken etc. for the tests to be carried out. The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.			
2.00.00	SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS			
2.01.00	The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below: i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test. ii) Dry Heat test as per IEC-68-2-2 or equivalent. iii) Damp Heat test as per IEC-68-2-3 or equivalent. iv) Vibration test as per IEC-68-2-6 or equivalent. v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent. vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent. vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent. Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.			
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3.00.00	TYPE TEST REQUIREMENT FOR C&I SYSTEMS					
	Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
	1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
	2	Thermocouple	Degree of protection test	IS-2147	No	No
	3	CJC Box	Degree of protection test	IS-2147	No	No
	4	RTD	As per standard (col 4)	IEC-60751	No	No
	5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
	6	E/P converter	As per standard (col 4)	Mfr. standard	No	Yes
	7	Instrumentation Cables Twisted & Shielded				
		-Conductor	Resistance test	VDE-0815	Yes	Yes
			Diameter test	IS-10810	Yes	Yes
			Tin Coating test (Persulphate test)	IS-8130	Yes	Yes
		-Insulation	Loss of mass	VDE 0472	Yes	Yes
			Ageing in air ovens**	VDE 0472	Yes	Yes
			Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
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			Heat shock	VDE 0472	Yes	Yes
			Hot deformation	VDE 0472	Yes	Yes
			Shrinkage	VDE 0472	Yes	Yes
			Bleeding & blooming	IS-10810	Yes	Yes
		-Inner sheath***	Loss of mass	VDE 0472	Yes	Yes
			Heat shock	VDE 0472	Yes	Yes
			Cold bend/ cold impact test	VDE 0472	Yes	Yes
			Hot deformation	VDE 0472	Yes	Yes
			Shrinkage	VDE 0472	Yes	Yes
		-Outer sheath	Loss of mass	VDE 0472	Yes	Yes
			Ageing in air ovens**	VDE 0472	Yes	Yes
			Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
			Heat shock	VDE 0472	Yes	Yes
			Hot deformation	VDE 0472	Yes	Yes
			Shrinkage	VDE 0472	Yes	Yes
			Bleeding & blooming	IS-10810	Yes	Yes
			Colour fastness to water	IS-5831	Yes	Yes
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-10 TYPE TEST REQUIREMENTS		PAGE 4 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
			Cold bend/ cold impact test	VDE-0472	Yes	Yes
			Oxygen index test	ASTMD- 2863	Yes	Yes
			Smoke Density Test	ASTMD- 2843	Yes	Yes
			Acid gas generation test	IEC-60754- 1	Yes	Yes
		-fillers	Oxygen index test	ASTMD- 2863	Yes	Yes
			Acid gas generation test	IEC-60754- 1	Yes	Yes
		-AL-MYLAR shield	Continuity test		Yes	Yes
			Shield thickness		Yes	Yes
			Overlap test		Yes	Yes
		-Over all cable	Flammability Test	IEEE 383	Yes	Yes
			Swedish Chimney Test	SEN 4241475	Yes	Yes
			Noise interference	IEEE Trans- actions	Yes	Yes
			Dimensional checks	IS 10810	Yes	Yes
			Cross talk	VDE-0472	Yes	Yes
			Mutual capacitance	VDE-0472	Yes	Yes
			HV test	VDE-0815	Yes	Yes
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
			Drain wire continuity		Yes	Yes
	* For Drain wire only					
	**These tests shall be carried out as per VDE0207 Part 6 & ASTM D-2116 for TEFLON insulated & outer sheathed cables					
	***Applicable for armoured cables only					
	8	DC Power Supply System (Applicable for each model and rating)				
			Degree of protection test	IS-13949	Yes	Yes
			Short circuit current capability	Approved procedure	Yes	Yes
			Voltage Proof Test	UL 950, IEC950	Yes	Yes
			Burn In test	Approved procedure	Yes	Yes
			Efficiency	Approved procedure	Yes	Yes
			Audible Noise Test	Approved procedure	Yes	Yes
			Fuse Clearing Capability	Approved procedure	Yes	Yes
			Total harmonic content	Approved procedure /CIGRES	Yes	Yes
			Radio Frequency interference	IEC-CISPR22, IEC-61000-4-12(9b), IEC-61000-4-3, IEC-61000-4-5, IEC-61000-4-6	Yes	Yes
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
			Over Load Test	Approved procedure	Yes	Yes
			Restart Test	Approved procedure	Yes	Yes
			Output voltage tolerance	Approved procedure	Yes	Yes
			Parallel operation	Approved procedure	Yes	Yes
			ESD immunity Test	IEC-61000-4-2-9(1)	Yes	Yes
			Electrical Fast transient/Burst Immunity Test	IEC-61000-4-4	Yes	Yes
			Surge Protection	IEC61312, IEC61024, VDE 100-534	Yes	Yes
			Insulation Test	Approved procedure	Yes	Yes
			Load Tests.	Approved procedure	Yes	Yes
			Preliminary light load test (without Battery supply)	Approved procedure	Yes	Yes
			Load sharing	Approved procedure	Yes	Yes
	9	Battery	As per standard	IS-10918	No	Yes
	10	Voltage Stabiliser	Over Load Test	Approved procedure	No	Yes
			Temp rise test without redundant fans	Approved procedure	No	Yes
			Input voltage variation test	Approved procedure	No	Yes
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
	11	DDCMIS				
		CLCS Systems	Model test	Approved procedure	Yes	Yes
		BMS	Safety requirements	VDE0116 Sec 8.7	No	Yes
	12	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
	13	Local Gauges	Degree of protection test	IS-2147	No	No
	14	Process actuated Switches	Degree of protection test	IS-2147	No	No
	15	Control Valves	CV test	ISA 75.02	Yes	Yes
	16	PLCs	As per standard	IEC 1131	No	No
	17	LIE / LIR /Junction Box	Degree of protection test	IS-2147	Yes	Yes
	18	Flue gas O2 analyser, other Flue Gas analysers	Degree of protection test	IS-2147	No	Yes
	19	Flow Nozzle Orifice plates	Calibration	ASME PTC BS 1042	Yes	Yes
Note: Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.						
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-10 TYPE TEST REQUIREMENTS	PAGE 8 OF 8	

CLAUSE NO.	TERMINAL POINTS 			
1.00.00	TERMINAL POINTS			
1.01.00	Steam Generator and Auxiliaries The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package.			
1.01.01	Flue Gas Duct The flue gas ducts from the ID fans, shall terminate (at Terminal Point/TP) as a circular section, of approximately 4.30 meters diameter, inside the chimney, at EL (+) 35.00M (minimum) to connect with the flue liner of the same diameter. Atleast, the top five meters of the transition ducting, below the TP, shall be (cylindrical) with the stated circular section. Therefore, the scope of the Bidder, shall include the transition ducting from the expansion joint just outside the chimney upto the TP, its supporting structure inside the chimney and the mating flange with adequate stiffening, below the TP, to connect with the other mating flange of the chimney flue liner (to be provided by Chimney Builder) above the TP. Each transition ducting and its supporting structure shall be adequately designed, by the Bidder, to take an additional load of 15 MT of the flue liner can/segment, to be supported on it, provided by the Chimney Builder. The transition ducting shall be so designed that no thermal loads are transferred to the chimney flue liner and the chimney shell due to the horizontal expansion of the transition ducting. The details of arrangement are indicated in Drawing No. 4610-101-POC-A-001			
1.02.00	Ash Handling System The ash handling plant is excluded from the scope of supply. The scope of ash handling system contractor shall start from the following terminal points of Main Plant Package, Part-A (Steam Generator with ESP). - Boiler Bottom Seal Plates and Drip Meshes. - Air Heater Ash Hopper Outlet Flanges. - Economizer Hopper Outlet Flanges. - Duct Hopper Outlet Flanges (if any). - ESP Hopper Outlet Flanges.			
1.03.00	Power Cycle Piping :			
1.03.01	Steam Service a) Main Steam : Inlet nozzle on HP Turbine			
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CLAUSE NO.	TERMINAL POINTS			
1.03.02	b)	Cold Reheat	:	Outlet nozzle of HP Turbine
	c)	Hot Reheat	:	Inlet nozzles on the IP Steam Turbine
	d)	Extraction-6 to HP Heaters, BFPTs, Deaerator, gland sealing	:	Tee-off/stubs provided on CRH Piping.
	e)	LP Bypass	:	(i) Inlet and outlet nozzle of LPBP Valve. (ii) Inlet nozzles on condenser
	f)	LP Bypass warm-up line	:	Stubs provided on HRH Piping
	g)	HP Bypass	:	(1) Steam inlet and outlet nozzles of HPBP Valve (2) Inlet and outlet of Breakdown orifice plate assembly.
	h)	HP Bypass warm-up line	:	Stubs provided on HP Bypass Line
	i)	HPT exhaust steam evacuation line	:	Stub provided on CRH line
	Note:			
	a) ESVS(s)/IVs/Control valves / strainers on Main steam & Hot Reheat piping system, HP Bypass Valve & its associated Break Down orifice plate assembly, LP Bypass Valve and non-return valves on Cold Reheat lines are excluded from the scope of supply of this package. b) Warm-up line for HP By pass & LP By pass and HPT exhaust steam evacuation line are excluded from the scope of supply of this package.			
Feed Water Service				
	a)	Inlet of NRV at inlet of economizer inlet		
	b)	RH Spray : Inlet of block valve(s) at upstream of RH spray control station.		
	c)	SH Spray : Inlet of block valve(s) at upstream of SH spray control station.		
	d)	Spray to Aux. PRDS : Stub(s) provided on Boiler Feed Water Discharge / Condensate discharge piping system in BC Bay.		
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CLAUSE NO.	TERMINAL POINTS			
1.03.03	Auxiliary Steam System a) The stub/Tee-off connections with isolation valve on the auxiliary steam header(s) (HT / LT -unit header) for the turbine system users. b) Isolating valve and blank flange on the auxiliary steam header(s) (HT / LT-unit/station headers) for future connections. d) TP for auxiliary steam piping to other auxiliary services shall be as indicated in the tender drg or as specified elsewhere in this chapter.			
1.03.04	Auxiliary Steam For Other Auxiliaries: (i) Auxiliary Steam for Air Conditioning system Contractor shall provide one steam pipeline connection with isolation valves up to near AC plant room of main plant TG building for further interconnection by Employer to their Vapor absorption type chillers of Air Conditioning plant. The saturated steam shall be supplied at a pressure of 8 kg/Sqcm (g) at the terminal point and the quantity of steam required shall be 6 tons/hr for main plant AC system. Contractor to ensure reliable and continuous steam supply even when only one of the unit is working. (ii) For Fuel Oil Unloading Area Contractor shall provide one steam pipe line connection with an isolation valve to supply minimum 25 T/hr. of auxiliary steam at 16 ata and 210 deg. C at around 2 meters outside the fuel oil pressurizing pump house building for Employer's fuel oil unloading and storage system.			
1.04.00	Fuel Oil Handling and Storage System 1. Flange of the Heavy oil unloading hose for connection to the road tankers. 2. Flange of the LDO unloading hose for connection to the road tankers. 3. Flange of the steam/condensate hose for connection to the road tankers. 4. Discharge connection of the water pump at the oil water separator pit to be terminated at the nearest plant drain. 5. Outlet of the flash tank to be terminated at the nearest plant drain.			
1.05.00	Mill Reject System Discharge flange of the mill reject storage silo for discharging the mill rejects in the trucks.			
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CLAUSE NO.	TERMINAL POINTS 			
1.06.00	Plant Water System			
1.06.01	Equipment Cooling Water System for Unit (SG) Auxiliaries (a) Bidder to refer the relevant tender drawing. (b) For each unit, Employer shall terminate one secondary circuit cold water (from the discharge of Auxiliary cooling water pumps at the downstream of self cleaning filters) at a suitable location along C-row to enable the Bidder to cool the primary DM cooling water in their Plate type Heat (PHE's) exchangers. The cooling water flow shall be about 900 Cu.M/hr at a design temperature of about 36 deg.C and at a suitable pressure. (c) For each unit, the Bidder shall terminate one secondary circuit hot water (from the discharge of Bidder's Plate type heat exchangers at suitable location along C-row to enable the Employer to interconnect the same to the discharge header of Circulating Water System pipes at the downstream of TG Condenser. The hot secondary cooling water circuit flow of 900 Cu.M/hr shall be limited to a temperature rise of 7 deg.C across the bidder's cooling system and the pressure drop across the secondary circuit shall be limited to 18 MWC between the terminal points. (d) For each unit, Employer shall terminate one DM water fill (normal supply) connection to interconnect the same to Bidder's ECW overhead tank. The connection shall be provided at about 4 meters above local grade level near C-row at a terminal pressure of about 4 Kg/Sq.cm (g) for further interconnection by the Contractor. (e) For each unit, Employer shall terminate one condensate water fill connection (emergency supply) to interconnect the same to Bidder's ECW overhead tank. The connection shall be provided at about 4 meters above local grade level near C-row at a terminal pressure of about 4 Kg/Sq.cm (g) for further interconnection by the Contractor. (f) For meeting the cooling water requirement of Employer's auxiliaries related to ash handling system a single terminal point of DM cooling water at local grade level near Dry ash air compressor house shall be provided by the contractor. The flow required for entire ash handling system of the employer shall be 400 cum/hr. The above quantity shall be tapped from the primary circuit of each unit and terminated at the above location by Contractor. The return hot water pipes shall be terminated by the Employer at the same location at a temperature of 43 deg C. The pressure drop in the Employer's ash handling system circuit (between the supply and return terminal points) shall not be more than approx. 4 kg/sq cm.			
1.06.02	Service Water System a) For each main SG unit, Employer shall provide one service water (which is of CW blow down quality) connection with an isolation valve at a pressure of about 4 Kg/sq.cm (g) near C-row, at about 4 meters above local grade level for further interconnection by Contractor to meet the service water network			
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CLAUSE NO.	TERMINAL POINTS			
	demand of respective SG & their auxiliaries including Fuel Oil Coolers though a set of tanks, pumps (if required) etc as per their system requirement. b) For Auxiliary Boiler, Employer shall provide one Service water (which is of CW blow down quality) connection with an isolation valve near the auxiliary boiler at a distance of 5 metres from Aux. Boiler envelope at about 4 meters above local grade level for further interconnection by Contractor to meet the service water network of respective Auxiliary boiler & their auxiliaries though a set of tanks, pumps (if required) etc as per their system requirement. Any cooling water requirement of the auxiliaries of Auxiliary Boiler may be served by this service water and hot water from the coolers shall be led upto the Employer's nearest drainage network. c) For FGD system, employer shall terminate one pipe connection for makeup (which is of CW blow down quality) of process water, near FGD area for further storing & pumping process water to FGD system by Contractor. The pipe shall be terminated at a pressure of about 10 mWC above local grade level for further interconnection by Contractor.			
1.07.03	Boiler Fill Water System – For Main and Auxiliary Boilers			
	(a) For each main SG unit, Employer shall provide one Boiler fill water connection of DM water quality with an isolation valve near C-row, at about 4 meters above local grade level for further interconnection by Contractor. (b) For Auxiliary Boiler, Employer shall provide DM water connection from Boiler fill pumping system with an isolation valve near the Aux. boiler at a distance of 5 metres from Aux. Boiler Envelope suitable location at about 4 meters above local grade level for further interconnection by Contractor to the DM storage/ feed water tank of Auxiliary Boiler.			
1.06.04	Air Pre-heater & ESP Wash Water System			
	For each unit, Employer shall provide one wash water connection with an isolation valve near C-row at about 4 meters above local grade level for further interconnection by Contractor to meet Air Pre-heater & ESP wash water system.			
1.06.05	Fire Water Supply for Fire Protection System of Air Pre-heaters and Coal Mills			
	From the plant hydrant fire hydrant network, Employer shall provide one pipe (per unit) connection with an isolation valve at a terminal pressure of about 6 Kg/sqcm (g) near C-row, at about 4 meters above local grade level for further interconnection by Contractor to meet the fire water requirement of Air preheater and coal mills. The maximum flow expected from the hydrant system shall be 400 Cu.M/hr.			
1.06.06	Employer shall provide one DM water connection at 10 meters from Auxiliary boiler at about 4.0 Meters from local grade level at a pressure of about 2 kgf/cm² for further interconnection by the Contractor.			
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CLAUSE NO.	TERMINAL POINTS			
1.08.00	Liquid Effluents			
1.08.01	The Contractor shall terminate all the condensate drains resulting from boiler blow down into a common sump for all units at one location to enable the Employer to treat and recycle/dispose of the same.			
1.08.02	The fuel oil (HFO & LDO) effluents from the separator pit is water, as fuel oil is recirculated into the system. The effluent water shall be connected to the nearest plant drain.			
1.09.00	Compressed Air System			
1.09.01	Instrument Air System			
	a) The terminal point details of instrument air piping at compressor house and near air receiver shall be referred in relevant tender drawing. b) For main SG each unit, Employer shall provide one instrument air connection from the instrument air ring main of the respective unit near C-row, at about 9 meters above local grade level for further interconnection by the bidder to meet the instrument air requirements. c) For Auxiliary Boiler, Employer shall provide one instrument air connection near the Auxiliary Boiler at a suitable location at about 9 meters above local grade level for further interconnection by the bidder to meet the instrument air requirement if any. d) For FGD system, Employer shall provide one instrument air connection near the FGD Plant at a suitable location at about 9 meters above local grade level for further interconnection by the bidder to meet the instrument air requirement if any. e) The pressure at terminal points shall be about 6 Kg/Sq.cm(g).			
1.09.02	Service Air System			
	a) The terminal point details of Service air piping at compressor house shall be referred in relevant tender drawing. b) For main SG each unit, Employer shall provide one service air connection from the service air ring main of the respective unit near C-row, at about 9 meters above local grade level for further interconnection by the bidder to meet the service air requirements of main SG unit except for the mill reject system. For mill reject system Bidder to provide independent compressed air system as specified elsewhere. c) For Auxiliary Boiler, Employer shall provide one service air connection near the Auxiliary Boiler at a suitable location at about 9 meters above local grade level for further interconnection by the bidder to meet the service air requirement if any.			
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CLAUSE NO.	TERMINAL POINTS				
	d)	For FGD system, Employer shall provide one service air connection near the FGD Plant at a suitable location at about 9 meters above local grade level for further interconnection by the bidder to meet the service air requirement if any.			
	e)	The pressure at terminal points shall be about 6 Kg/Sq.cm(g)			
1.10.00	All interconnections of matching flanges/expansion joints/piping/ducting etc, between employer supplied equipment/equipment supplied by other contractors and contractor supplied items at terminal points specified above shall, however, be in the scope of Steam Generator Contractor.				
1.11.00	Electrical				
	Terminal points of Contractor's electrical scope, applicable for all systems/subsystems described in relevant clauses for SCOPE is given below :				
1.11.01	Incoming power supply terminals of LT MCCs, ESP MCC/ ACP, FGD MCC,DC starter boxes and distribution boards under contractors scope of work.				
1.11.02	Incoming power supply terminals of Controller panels for TR set/Rapping system/heating system, as applicable, under contractors scope of work.				
1.12.00	Control & Instrumentation				
	(a)	Upto and including reducers after root valves for Employer furnished instruments to be mounted on the contractor's equipment / piping (connection/welding of Employer's impulse piping to Contractor's root valves/reducers to be done by the Employer).			
	(b)	1. Upto and including local junction boxes or Integral junction box of LIE/LIR for primary instruments except for temperature elements to be used in Employer's DDCMIS etc (Employer's cable to Contractor's local JB to be connected by Employer). 2. Upto Employer's temperature transmitters for temperature elements to be provided by Contractor and to be used in Employer's DDCMIS etc., cable and its termination. 3. Contractor's marshalling cabinets for hardwired signal exchange with TG C&I/Station C&I system. 4. Contractor's HMIPIS system cabinet/Network Switch for communication with Station C&I System.			
	(c)	Stubs for Employer furnished temperature elements (connection/welding of Employer's temperature elements to Contractor's stubs to be done by Employer).			
	(d)	Reducer after shut off valves for sample tapping points for Employers SWAS. (connection/welding of Employer's sample piping to be done by the Employer).			
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CLAUSE NO.	TERMINAL POINTS			
	(e) Local control panels (wherever provided) cabling between Contractor's local control panels and employer's DDCMIS to be done by Employer. (f) For manually operated valves, Limit switches where specified shall be wired to the terminal boxes / JB provided on the valves. (g) Limit / Process activated switches on various tanks / field elements / actuators where specified shall be connected by the Contractor to the local junction boxes to be supplied by the Contractor.			
1.13.00	COAL			
1.13.01	Raw Coal Bunker Outlet flanges.			
1.14.00	LIMESTONE			
1.14.01	Limestone Bunker Outlet flanges (Refer tender drawings Drg No. 4610-101-POM-A-006 Sh 2 of 3)			
1.15.00	GYPSUM			
1.15.01	Gypsum belt filter discharge chute (Refer tender drawings Drg No. 4610-101-POM-A-006 Sh 3 of 3)			
1.16.00	FGD SYSTEM WASTE WATER			
1.16.01	Waste water pump outlet at employer's ash slurry sump (Refer tender drawings Drg No. 4610-101-POM-A-006 Sh 3 of 3)			
2.00.00	EXCLUSIONS			
2.01.00	Coal Handling Plant, Railway Siding			
2.02.00	Ash Handling Plant			
2.03.00	Turbine Generator Plant			
2.04.00	Plant make-up Raw water system			
2.05.00	Cooling Tower, CW pumps, CW pump house and CW channel.			
2.06.00	Ventilation system make-up pumps, CW system make-up pumps, Air pre-heater wash water pumps, Boiler fill pumps, DM water make up pumps and Condensate transfer pumps.			
2.07.00	Air Conditioning System.			
2.08.00	Ventilation System			
2.09.00	Common Fire fighting system and Equipment (unless specifically included in scope).			
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CLAUSE NO.	TERMINAL POINTS			
2.10.00	Water Pre-treatment, DM Plant, Chlorination plant, CW side stream filtration plant and CW chemical treatment system, Liquid effluent treatment plant, Ash water recirculation system and Ash water treatment plant.			
2.11.00	Chimney and the chimney steel flues from the transition piece terminal points onwards.			
2.12.00	HT Cables			
2.13.00	Illumination System			
2.14.00	Underground earth mat			
2.15.00	TG (C&I) and BOP (C&I) part of DDCMIS, sequence events recording function and station LAN.			
2.15.01	Unit control desk unit control panel to be located in control room.			
2.15.02	Large video screen			
2.15.03	Centralized steam and water analysis system including sample piping for the same from shut off valves reducers onwards,			
2.15.04	Uninterruptible Power supply system (240 V single phase AC) for Steam Generator System			
2.15.05	Maintenance and calibration equipment required for routine maintenance and calibration of general instrumentation which are not in Contractor's scope.			
2.15.06	System / shield earth cable to employer's earthing strip at 0.0 m level.			
2.16.00	All Civil, Structural & Architectural works for Main Power House, Service Building, Mill & Bunker Building including raw coal bunkers, ESP control building, Transfer Points, conveyor galleries in Boiler area, Fuel Oil pressuring pump house, Fuel Oil unloading Pump House, Fuel Oil Tank foundations and other related to fuel oil unloading facilities.			
2.17.00	All foundation works including area pawing and RCC pit for Boiler Elevator (The foundation bolts, inserts and grouting of foundation are in Bidder's Scope.)			
2.18.00	RCC deck over spring units & viscous damper units, wherever provided.			
2.19.00	Limestone unloading, storage and handling system.			
2.20.00	Gypsum handling, storage and handling system.			
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS			
1.00.00	GENERAL			
1.01.00	The term “Performance Guarantees” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Functional Guarantees”. Similarly the term “Performance Tests” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Guarantee Test(s)”.			
1.02.00	The term "BMCR" (Boiler maximum continuous Rating) appearing in the technical specification shall mean the maximum continuous steam output of Steam Generator (i.e. 810 T/Hr) at superheater outlet at rated parameters.			
1.03.00	The term “TMCR” (Turbine maximum continuous rating) appearing in the technical specification shall mean 250 MW electrical power output at generator terminals under 0% cycle make-up and design condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure.			
2.00.00	PERFORMANCE GUARANTEES / PERFORMANCE TESTS			
2.01.00	General Requirements			
2.01.01	The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.			
2.01.02	The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.			
2.01.03	The Contractor shall conduct performance test and demonstrate all the guarantees covered herein under Category I, II & III. The various tests which are to be carried out during performance guarantee tests are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.			
2.01.04	All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.			
2.01.05	The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.			
2.01.06	The Contractor shall make the plant ready for the performance guarantee tests.			
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2.02.00	Test Instrumentation, Flow Measurement and their Calibration All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermo wells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost. The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure including demonstration tests shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.			
2.02.01	The P&G test procedures shall be submitted for equipments/ system & subsystem under Contractor's scope for all Guarantees under category I, II & III as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.			
2.02.02	The contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following: (a) Object of the test (b) Various guaranteed parameters & tests as per contract. (c) Method of conductance of test and test code. (d) Duration of test, frequency of readings & number of test runs. (e) Method of calculation. (f) Correction calculations & curves. (g) Instrument list consisting of range, accuracy, least count, and location of instruments. (h) Scheme showing measuring points. (i) Sample calculation (j) Acceptance criteria. (k) Any other information required for conducting the test. The Performance test shall be carried out as per the agreed procedure.			
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2.03.00	Test Reports After the conductance of Performance test, the Contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Employer after completing each test run. Four (4) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Employer for approval.			
2.03.01	The performance guarantee test will be carried out within three months after the successful completion of Initial Operation of facilities or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the EMPLOYER. In the event of EMPLOYER agreeing to conductance of such tests after three months, for reasons not attributable to the EMPLOYER, as assessed by the Employer, no factor for ageing shall be considered for computing performance of the equipment.			
2.03.02	Performance Guarantee Tests on the equipments/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed specifications, Sub-sections in Part-B, Section-VI.			
2.03.03	Acceptance of Guarantee Test Results In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit as specified at clause 4.00.00 of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 4.00.00 of this sub-section. However, if, the demonstrated guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit/ Specified Performance Criteria, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following: (i) For Category-I Guarantees Reject the equipment / system / plant and recover from the Contractor the payments already made 			

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	liquidated damages shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees. (ii) For Category-II Guarantees Reject the equipment / system/ plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category-II' Guarantees. Conformance to the performance requirements under Category-II is mandatory. (iii) For Category-III Guarantees Reject the equipment /system / plant and recover from the Contractor the payments already made. OR Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as "Category-III" Guarantees. 3.00.00 GUARANTEES UNDER CATEGORY-I 3.01.00 The Performance Guarantees which attract Liquidated Damages (LD) are as follows: (i) Steam generator efficiency: (a) Efficiency of the Steam Generator at 100% TMCR (250 MW unit load) with 27Deg.C ambient temperature and 60% RH, while firing the design coal (blended) specified in Table-1(C), Sub section V, Part A, Section VI, at rated steam parameters, rated coal fineness and rated excess air. (To be demonstrated as per clause 9.00.00 of this sub-section). (b) Efficiency of the Steam Generator at 80% TMCR (200 MW unit load) with 27Deg.C ambient temperature and 60% RH, while firing the design coal (blended) specified in Table-1(C), Sub section V, Part A, at rated steam parameters, rated coal fineness and rated excess air. (To be demonstrated as per clause 9.00.00 of this sub-section). (ii) Steam Generating Capacity: Steam generating capacity in T/hr of steam at rated steam parameters at super heater outlet (with any combination of mills working as per Employer's			
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	discretion) with the coal being fired from within the range specified in Table-1(C), Sub section V, Part A, Section VI. (iii) Feed water pressure required at Economizer inlet (at Stop Valve inlet) Feed water pressure at Economizer inlet for main steam flow from corresponding to 100% TMCR (250 MW unit load). (iv) Super heater attemperation spray water flow (In case the spray water is tapped off from upstream side of top H.P. heater) In case spray water is tapped off from upstream side of last HP Heater, the Contractor shall carry testing to prove that for all guaranteed Steam Generator loads, the spray water flow for SH attemperation system does not exceed the guaranteed value of main steam flow at respective loads at super heater outlet while firing design coal specified with HP heaters in service (to be indicated in the Bid) while maintaining the rated SH steam temperatures at all loads within the control range of the Steam Generator uptown and including TMCR. The following shall be guaranteed and tested: (a) Super heater Spray flow while firing design coal (blended) specified in Table-1(C), Sub section V, Part A and maintaining rated SH outlet steam temperature at 100% TMCR (250 MW unit load). (b) Super heater Spray flow while firing design coal (blended) specified in Table-1(C), Sub section V, Part A and maintaining rated SH outlet steam temperature at 80% TMCR (200 MW unit load). (v) Coal Mill Wear Parts Warranty Life of coal pulveriser wear parts, in hours of operation, for the entire range of coal characteristics specified. (to be demonstrated as per clause 10.00.00 of this sub-section). (vi) Particulate Emission/ ESP efficiency Particulate emission from ESP shall not be more than 31 mg/Nm³ under guarantee point condition as specified in Part B of Technical Specification at 100% TMCR (250 MW unit load) with design coal (blended) firing specified in Table-1(C), Sub section V, Part A. The corresponding ESP efficiency shall be worked out as per the procedure outlined in clause 11.00.00 of this subsection. (vii) SO₂ Removal efficiency of FGD system SO₂ removal efficiency of the Flue Gas Desulphurization (FGD) system, not less than 95% under Guarantee Point Conditions stipulated in clauses nos. 1.02.00 of Part B, Sub Section M4.			
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4.00.00	(viii) Limestone consumption of FGD system Limestone consumption of FGD system in kg/hr at 100% TMCR (250 MW unit load) under Guarantee Point Conditions stipulated in clauses nos. 1.02.00 of Part B, Sub Section M4 and SO₂ removal efficiency of not less than 95%. (ix) Auxiliary Power Consumption (a) Auxiliary Power Consumption at 100% TMCR (250 MW) unit load. The total auxiliary power consumption for all the equipments and auxiliaries related to steam generator, ESP, FGD, Equipment Cooling water pumps, Mill Reject Handling system, Compressed air system, etc. required for continuous unit operation at 100% TMCR (250 MW unit load) with rated steam conditions and with ambient air temperature of 27 deg.c. & RH of 60%, with 3% cycle make-up shall be guaranteed in line with the requirements stipulated in clause 6.00.00 of this sub-section. Further, the set point for the hopper heater temperature control during the performance guarantee testing shall not be less than the average flue gas temperature at ESP inlet during the test. (b) Auxiliary Power Consumption at 80% TMCR (200 MW) unit load. The total auxiliary power consumption for all the equipments and auxiliaries related to steam generator, ESP, FGD, Equipment Cooling water pumps, Mill Reject Handling system, Compressed air system, etc. required for continuous unit operation at 80% TMCR (200 mw unit load) with rated steam conditions and with ambient air temperature of 27 deg.C. & RH of 60%, with 3% cycle make-up, shall be guaranteed in line with the requirements stipulated in clause 6.00.00 of this sub-section. Further, the set point for the hopper heater temperature control during the performance guarantee testing shall not be less than the average flue gas temperature at ESP inlet during the test. Note: Power consumption of each of the pump/fan/compressors/coal pulveriser /heater etc. wherever mentioned shall be measured with its own drive. AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR CATEGORY-I GUARANTEES The rate of liquidated damages and acceptable shortfall limits for different Category – I guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price.			
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	<table><tr><th>Sl.No</th><th>Guarantee Description</th><th>Rate of Liquidated Damage (LD)</th><th>Acceptable Shortfall Limit with LD</th></tr><tr><th>(1)</th><th>(2)</th><th>(3)</th><th>(4)</th></tr><tr><td>i)</td><td colspan="3">Steam Generator Efficiency For shortfall in guaranteed Steam Generator efficiency in percentage points under conditions stipulated in clause 3.01.00 (i) of this Sub-Section and elsewhere in this specification at :</td></tr><tr><td>a)</td><td>100% TMCR (250 MW unit load)</td><td>US \$ 569 839 (US dollar Five hundred sixty nine thousand eight hundred thirty nine only) for every 0.1% shortfall in efficiency</td><td>(-) 0.5% points from the guaranteed efficiency</td></tr><tr><td>b)</td><td>80% TMCR (200MW unit load)</td><td>US \$ 462 661 (US dollar Four hundred sixty two thousand six hundred sixty one only) for every 0.1% shortfall in efficiency</td><td>(-) 0.5% points from the guaranteed efficiency</td></tr><tr><td>ii)</td><td colspan="3">Steam generator capacity For shortfall in the guaranteed steam generating capacity in T/Hr of steam at rated parameters at superheater outlet (with any combination of mills working as per Employer's choice), the coal being fired from within the range specified for blended coals.</td></tr><tr><td>iii)</td><td colspan="3">Feed water pressure required at Economiser inlet (at Stop Valve inlet) For every 1 kg/cm² (absolute) increase in Feed water pressure from guaranteed value at Economiser inlet for main steam flow corresponding to 100% TMCR (250 MW unit load)</td></tr><tr><td></td><td></td><td>US \$ 73 242/- (US dollar Seventy three thousand two hundred forty two only) for every1 kg/cm² (absolute) increase in feed water pressure at Economiser inlet.</td><td>(+)5 kg/cm² (absolute) from the guaranteed value.</td></tr></table>				Sl.No	Guarantee Description	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD	(1)	(2)	(3)	(4)	i)	Steam Generator Efficiency For shortfall in guaranteed Steam Generator efficiency in percentage points under conditions stipulated in clause 3.01.00 (i) of this Sub-Section and elsewhere in this specification at :			a)	100% TMCR (250 MW unit load)	US \$ 569 839 (US dollar Five hundred sixty nine thousand eight hundred thirty nine only) for every 0.1% shortfall in efficiency	(-) 0.5% points from the guaranteed efficiency	b)	80% TMCR (200MW unit load)	US \$ 462 661 (US dollar Four hundred sixty two thousand six hundred sixty one only) for every 0.1% shortfall in efficiency	(-) 0.5% points from the guaranteed efficiency	ii)	Steam generator capacity For shortfall in the guaranteed steam generating capacity in T/Hr of steam at rated parameters at superheater outlet (with any combination of mills working as per Employer's choice), the coal being fired from within the range specified for blended coals.			iii)	Feed water pressure required at Economiser inlet (at Stop Valve inlet) For every 1 kg/cm ² (absolute) increase in Feed water pressure from guaranteed value at Economiser inlet for main steam flow corresponding to 100% TMCR (250 MW unit load)					US \$ 73 242/- (US dollar Seventy three thousand two hundred forty two only) for every1 kg/cm ² (absolute) increase in feed water pressure at Economiser inlet.	(+)5 kg/cm ² (absolute) from the guaranteed value.
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	(1)	(2)	(3)	(4)
	iv)	Superheater attemperation spray water flow (In case the spray water is tapped off from upstream side of last H.P. heater)		
		For every 1 T/Hr increase in spray flow over guaranteed value while firing design coal and maintaining rated SH outlet steam temperature at		
	a)	100% TMCR (250 MW unit load)	US \$ 9 373/- (US dollar Nine thousand three hundred seventy three only) for every one (1) Ton/Hr increase in spray flow over guaranteed value.	(+) 20% of the guaranteed SH spray water flow
	b)	80% TMCR (200MW unit load)	US \$ 7 628/- (US dollar Seven Thousand six hundred twenty eight only) for every one (1) Ton/Hr increase in spray flow over guaranteed value.	(+) 20% of the guaranteed SH spray water flow
	v)	Coal Pulveriser wear parts warranty		
		Life of coal pulveriser wear parts in hours of operation.	To be calculated as per clause 10.00.00 of this Sub-Section	(-) 500 hours
	vi)	For shortfall in guaranteed ESP efficiency in percentage points at conditions stipulated in clause 6.01.00 (vii) of this Sub-Section and elsewhere in this specification	US \$ 129 475/- (US Dollar One hundred twenty nine thousand four hundred and seventy five only) for every 0.01% point shortfall in ESP efficiency from the guaranteed value	(-) 0.05% point from the guaranteed ESP efficiency
	vii)	For shortfall in FGD system efficiency from the guarantee in % points at conditions stipulated in Cl. 3.01.00 (vii)	US \$ 28353 (US dollar twenty eight thousand three hundred fifty three only) for every 0.1% point shortfall in guaranteed efficiency.	(-) 1 % of the guaranteed FGD system efficiency.
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	(1)	(2)	(3)	(4)
ix)	Auxiliary Power Consumption			
	For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 6.01.00 (x) (a), (b) of this Sub-Section at :			
a)	100% TMCR (250 MW unit load)	US \$ 3 272 (US dollar Three thousand two hundred seventy two only) every kW increase in power consumption from the guaranteed value.	(+) 1% of the guaranteed auxiliary power consumption	
b)	80% TMCR (200 MW unit load)	US \$ 2 288 (US Dollar Two thousand two hundred eighty eight only) for every kW increase in power consumption from the guaranteed value.	(+) 1% of the guaranteed auxiliary power consumption	
NOTE :				
i)	Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.			
ii)	If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.			
iii)	All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC)			
iv)	Contractor's aggregate liability to pay Liquidated Damages(LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.			
5.00.00	SPECIFIC AND LIMITING REQUIREMENTS FOR STEAM GENERATOR EFFICIENCY			
5.01.00	Guaranteed Steam generator efficiency shall be calculated as per the requirements of BS EN 12952-15:2003 (by loss method) based on Gross Calorific Value (GCV) of coal and as per stipulations of Clause 9.00.00 of this Sub-Section.			
5.02.00	The guaranteed efficiency quoted by the Bidder shall comply with following limiting parameters with design coal firing :			
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	(a) Excess air at economizer outlet (at TMCR load) : 20% (min.) (b) Corrected flue gas temperature at air preheater outlet (at TMCR load) : 160 Deg.C. or as predicted by the Bidder whichever is higher (c) Loss due to unburnt carbon in ash (at all two guarantee point loads i.e. 80% and 100% TMCR) : 1.0% (min.) Bidder/Contractor to note that no credit shall be given in the bid evaluation or in the evaluation of the results of the guarantee tests for performance predictions/ guarantees etc. if the values considered by the Bidder/ Contractor for parameters indicated at a), b) & c) above are lower than those specified above.			
5.03.00	For the purposes of guarantees the ambient air temp. and relative humidity shall be taken as 27 deg.C. and 60% respectively.			
5.04.00	Unless otherwise specified, the guarantees shall be based on blended design coal firing with blended coal/ ash analysis as given in Table-1(C), Sub-Section-V of Part-A of Technical Specification.			
6.00.00	AUXILIARY POWER CONSUMPTION (PA) The unit auxiliary power consumption shall be calculated using the following relationship. $P_a = P_u + T_L$ P_a = Guaranteed Auxiliary Power Consumption. P_u = Power consumed by the auxiliaries of the unit under test. T_L = Losses of the transformers supplied by bidder based on works test reports. While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating under this package auxiliaries. The auxiliaries to be considered shall include but not be limited to the following :			
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	UNIT AUXILIARIES (to be considered for calculating Pu) (a) Mills. (b) PA Fans. (c) FD Fans. (d) ID Fans. (e) Air Heaters. (f) Coal Feeders. (g) Steam Generator Water Circulating Pump. (if applicable) (h) Seal Air Fans. (i) Lube oil pumps for fans, Air heaters, Mills, etc. (j) Scanner air fans. (k) Pressurizing pumps of fuel oil system (l) Electro Static Precipitator (with TR sets and hopper heaters of all ESP fields in service, insulator heater of all ESP fields/ pent house fan (as applicable) and rapping system in normal operation. (m) Flue gas desulphurization (FGD) system comprising of limestone pulverisers: A. Unit Auxiliaries i. Gas-Gas Heater and its Integral Auxiliaries ii. FGD Bypass Gate Seal Air fan iii. Absorber Recirculation Pump(s) iv. Absorber Oxidation Air Compressor(s) v. Absorber Oxidation Tank Agitators vi. Gypsum Bleed Pumps vii. Limestone Gravimetric feeder, Pulverizer and their integral Auxiliaries viii. Limestone Slurry Pumps ix. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries x. 67% of the power consumption of Process water pumps xi. 67% of the power consumption of Mist Eliminator Wash Water pumps			
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	B. Common Auxiliaries i. Limestone Slurry Tank Agitators (to be proportionally assigned to each unit based on unit load) ii. Filtrate Pumps (to be proportionally assigned to each unit based on unit load) iii. Belt Filter Wash Water Pump (if common pumps are provided for all belt filters, to be proportionally assigned to each unit based on unit load) iv. Hydro-cyclone Waste Water Sump Pump and Waste Water Pump (to be proportionally assigned to each unit based on unit load) The equipments listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption. Power consumption of all equipments provided on unitized basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption. (n) DM Cooling (normally working) Water pump to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit Auxiliaries) water system. (o) Power consumption of one instrument air compressor, one air drying plant and one service air compressor. (p) Compressor for Mill Reject Handling System. (q) Power consumption of any other continuously operating auxiliaries for unit operation at different guarantee point loads. Note : 1. The bidder shall furnish a list of equipments to be covered under auxilliary power consumption, which shall be subject to Employer's approval. 2. The equipments listed above for calculating auxiliary power consumption are indicative. Any other equipments required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption.			
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7.00.00	GUARANTEES UNDER CATEGORY-II			
7.01.00	The Performance Guarantees, conformance to which are mandatory are as follows :			
7.01.01	NOx emission Contractor shall guarantee that maximum total nox emission from the unit shall not be more than 260 grams of NOx per giga joule of heat input (from thermal as well as fuel) to the boiler during the entire operating range of steam generator for the range of coals specified. The emission shall be measured during steam generating capacity test. the bidder shall furnish the methodology of measurement and demonstration of variations w.r.t. load upto 50% of total load.			
8.00.00	GUARANTEES UNDER CATEGORY-III			
	The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:			
8.01.00	Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in Part-C of Section-VI of the technical specifications. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or is 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement additional measurement points shall be considered based on the applicable standards and the size of the equipment. the measurement shall be done with slow response on the a - weighting scale. the average of a-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. corrections for background noise shall be considered in line with the applicable standards. all the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.			
8.02.00	STEAM GENERATOR AND AUXILIARIES (i) Mill capacity at rated fineness Performance testing shall be done on each coal pulveriser toward establishing its capacity specified at the rated fineness, applying corrections for the variation in coal characteristics i.e. HGI & Total Moisture.			
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	The Contractor shall demonstrate a capacity output not less than the offered value for each mill with following conditions occurring simultaneously during testing: (a) Coal fineness : (a) not less than 70% through 200 mesh and : (b) not less than 99% through 50 mesh screen (b) Mill loading : Not to exceed 90% of maximum load. (c) Coal quality : All available coal from the specified Range of blended coals. Bidder shall guarantee that the above capacity will be maintained and demonstrated with the originally installed grinding elements in nearly worn-out condition or at the end of guaranteed wear life of grinding elements, whichever is earlier. In case the Contractor successfully demonstrates the guaranteed capacity on nos. of coal pulverisers required for 100% TMCR load of each Steam Generator as stated above, the remaining coal pulverisers of corresponding Steam Generator will also be considered to have successfully met the above capacity guarantee requirement. However, in the event of any of the these coal pulverisers not meeting the guarantee test, all the coal pulverisers of the corresponding Steam generator will have to be tested by the Contractor to demonstrate guaranteed capacity. Test shall also be conducted on one pulveriser(of Employer's choice) of each Steam Generator for establishing its capacity at 100% mill loading, at rated pulveriser coal fineness with specified blended design coal with new set of grinding elements. During the above mentioned operating period of the mill, manufacturer's operating instructions will be followed and mill will be operated with the specified range of coals without any such readjustment that requires a shutdown of the mill or reduction of the load and/or any replacement of any mill wear parts. For the purpose of testing to demonstrate the capacity, if HGI (grindability) and total moisture vary from those given in coal characteristics, the above pulveriser measured capacity shall be corrected using the capacity correction curves furnished by the Contractor and approved by the Employer. HGI versus coal pulveriser capacity curve shall be furnished for HGI variation upto a value above which the capacity remain constant. Capacity guarantee shall be conducted and demonstrated on each coal pulverisers individually.			
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	(ii) Ceramic Lining for Pulverised Fuel Pipes Contractor shall warranty the operating life of the ceramic lining for pulverised coal pipes. This warranty shall be demonstrated for groups of pipes connected to each mill as selected by the Employer. The establishment of above warranty will be based on the operating records available at the power station. Contractor shall warranty that the operating life of the ceramic lining for PF pipes as per requirements of Sub-Section-II, Part-B, Section-VI of Technical Specification. (iii) No fuel oil support shall be required above 40% BMCR Contractor shall guarantee that oil support for flame stabilization shall not be required beyond 40% of BMCR load when firing the coals from the range identified. The Contractor shall demonstrate that with any combination of mills/ adjacent mills in service (to Employer's choice) the Steam Generator does not require any oil firing for stable and efficient boiler operation at and above 40% BMCR loads. (iv) Performance characteristics of fans (capacity, head developed, etc.) (v) Capabilities of all drives (Refer Part B of Technical Specifications) (vi) Margins on fans<table><tr><td>(a)</td><td>Seal Air Fans</td><td>-</td><td>As specified in Part B of Technical Specifications</td></tr><tr><td>(b)</td><td>Primary Air Fans</td><td>-</td><td>As specified in Part B of Technical Specifications</td></tr><tr><td>(c)</td><td>Forced Draft Fan</td><td>-</td><td>As specified in Part B of Technical Specifications</td></tr><tr><td>(d)</td><td>Induced Draft Fan</td><td>-</td><td>As specified in Part B of Technical Specifications</td></tr></table> (vii) Run back capabilities Refer Part-B of Technical Specifications. (viii) Rate of change of load and sudden load change withstand capability Refer Part-B of Technical Specifications. (ix) Furnace Exit Gas Temperature (FEGT) The Contractor shall conduct a comprehensive thermal performance test (TPT) (on one unit only). Through such TPT the Contractor, by indirect measurement, shall demonstrate that the Furnace Exit Gas Temperature (FEGT) does not exceed the specified maximum temperature limit, with coal pulveriser combinations to Employer's choice and all other requirement in				(a)	Seal Air Fans	-	As specified in Part B of Technical Specifications	(b)	Primary Air Fans	-	As specified in Part B of Technical Specifications	(c)	Forced Draft Fan	-	As specified in Part B of Technical Specifications	(d)	Induced Draft Fan	-	As specified in Part B of Technical Specifications
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	line with sub-section-II:M-1, Part-B of Technical Specifications. The demonstration shall be done by backward calculations method, after having measured/tested/calculated the economizer outlet gas temperature (average), excess air (average), unit heat load (based on turbine flow and reheater flow), characteristics of coal being actually fired during testing, heat absorption in different stages of heat transfer equipments (based on steam/water temperature and pressure measurements) etc. FEGT for the specified blended design and blended worst coals shall be calculated using the measured FEGT (with test coal) as above and using computer modeling technique for necessary conversion of the results to the specified blended design and blended worst coals. The FEGT demonstration using computer modeling technique shall involve following steps: - Development of a computer field model (FM) (backward) using above measured/computed field data. This will be used to calculate the surface effectiveness factor (SEF) for each of heat transfer banks including furnace water walls with test coal. - The above field model shall have to be validated by various tests (loads, coal pulveriser combination etc. with test coal) to ensure SEFs for each bank are consistent (within $\pm 5\%$) for all tests. - Using above SEFs, for each heat transfer bank contractor's original boiler blended design model will be changed to make it Bongaigaon TPP specific. - The validity of the above model shall be checked for each test by feeding the test coal both from backward direction FM and the calibrated Bongaigaon TPP SPECIFIC model as per step-(c) above. The model validity is established if the results for flue gas temperature profile in the boiler, zonal assumption etc. is identical in both the 'BACKWARD' and 'FORWARD DIRECTION'. - The validated "Bongaigaon TPP Specific" model shall have "Fuel Switching" capability i.e. it shall be able to appropriately vary the furnace absorption with changes in the coal properties. Validation of the above fuel switching capability will also have to be established to the satisfaction of NTPC. - Having established and demonstrated FUEL SWITCHING capability, the contractual FEGT can be demonstrated by using the SITE SPECIFIC calibrated model as per step-(d) and plugging in the specified coal(s). The detailed procedure and the correction curves for the above test shall be to Employer's approval. (x) Cold Air Velocity Test (CAVT) A CAVT shall be conducted on each Steam Generator during commissioning and before its initial operation to establish the average cold air velocity and			
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	the velocity distribution at minimum three predetermined sections (Employer's Choice) of steam generator. The data obtained from the CAVT will be used to compute the actual flue gas velocities as well as their distribution at the test sections during actual operation by correlating the CAVT data with the test/computed data from Thermal Performance Test as per Clauses 8.02.00 (ix) & (xi) of this sub section. Should the CAVT results after this correlation with TPT data indicate actual localized high flue gas velocity zones/ maldistribution of gas flow and/or flue gas laning, suitably blended designed stainless steel screens at required SG cross sections shall be provided by the Contractor to bring the deviation of the localized gas velocity within $\pm 20\%$ of average gas velocity specified. Through this test the Contractor shall also demonstrate the compliance with the specification requirements regarding the maximum allowable flue gas velocities at various sections of the Steam Generator refer sub-section-II:M-1, Part-B of Technical Specifications. The detailed CAVT procedure shall be to Employer's approved. The Contractor shall submit a detailed CAVT report and the computations of actual velocities after correlating CAVT data with TPT data to the Employer for approval. (xi) Flue Gas Temperature (Actual/MHVT values) The Contractor through thermal performance test (TPT) as per clause Clauses 8.02.00(ix) above shall also demonstrate that the flue gas temperature at the entry and exit of various boiler heating surfaces and also the variations across the cross section perpendicular to gas flow do not exceed the values indicated in the data sheets for 100% TMCR (250 MW). (xii) Steam Temperature Imbalance The Contractor shall demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 deg.C under all loads including transients. (xvi) Air heater air in leakage Contractor shall to demonstrate that the air-heater air-in-leakage and maximum drift in air leakage do not exceed the guaranteed or specified value as per sub-section-II:M-1, Part-B of Technical specifications. Above requirement needs to be complied even with recirculation of flue gas from downstream of ESP. (xvii) Steam Generating Capacity with HP Heaters Out Contractor shall demonstrate steam generating capacity of Steam Generator when one and/or both or all strings of HP heaters are out of service, as offered. The metal temperature margins over the blended design value shall also be demonstrated for the most adverse operating conditions. (xix) Steam purity at drum outlet.			
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	ELECTROSTATIC PRECIPITATOR (xxiii) Contractor shall demonstrate that ESP air in leakage shall be limited to 1% of the total gas flow under guarantee point. (xxiv) Bidder shall demonstrate that the maximum ESP pressure drop do not exceed 20 MMWC under guarantee point. (xxv) Bidder shall demonstrate that ESP gas distribution in various streams and fields are in accordance with the IGCI publication EP-7 at guarantee point. (xxvi) Bidder shall demonstrate Aux. Steam Generator capacity at rated steam parameters at super heater outlet as indicated in the Part-B of Technical Specification. (xxvii) Bidder shall demonstrate maximum surface temperature measured over the cladding of insulation surface for Boiler, ESP, Piping etc. wherever applicable under the scope of this specification (as per design criteria specified in clause 21.00.00 of Sub-Section-II-M1/Part-B, Section-VI. FLUE GAS DESULPHURISATION (FGD) SYSTEM (xxviii) Pressure Drop The contractor shall demonstrate that the total pressure drop in the gas path across the absorber and gas-gas heater shall not exceed the guaranteed values at 100% TMCR, with Boiler firing the blended Design coal under conditions stipulated in sub-section M4, Part-B of the specification. The measured pressure drop shall be corrected to the gas flow corresponding to the above conditions for the demonstration. However, no correction will be allowed for increase in gas flow, except for variation due to coal properties and ambient conditions. (xxix) Stack inlet temperature The contractor shall demonstrate that the stack inlet temperature, with FGD system in operation, is more than or equal to 100°C at 100% TMCR with the boiler firing the blended Design Coal under conditions stipulated in sub-section M4, Part-B of the specification. However, no correction will be allowed for variation in gas temperature or gas flows except for change due to variations in ambient conditions and coal properties. (xxx) Limestone Pulverizer i) Lime Stone Pulverizer Wear Parts Guarantee Contractor shall demonstrate the life of pulverizer wear parts in line with requirements stipulated in Sub-Section-M4, Part-B of the Technical Specification. The establishment of the above guarantee shall be based			
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	on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation. ii) Capacity The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions: i) Limestone fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh. ii) Limestone Quality : All available quality from the specified range. Contractor shall demonstrate the above capacity with the originally installed grinding elements in nearly worn-out condition as mutually agreed for the purpose of ascertaining wear life of any of the wear parts. iii) Limestone pulverizer Ball Consumption The contractor shall guarantee and demonstrate the ball consumption of the limestone pulverizers in grams per ton of ground limestone. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed based on average ball consumption rate for a one year period. (xxxi) Vacuum Belt Filter Capacity Contractor shall demonstrate the capacity of the vacuum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in sub-section M4, Part-B of the specification. (xxxii) Vacuum Belt Filter Gypsum Quality The contractor shall demonstrate that the purity of the gypsum shall be not less than the specified value and the moisture content shall be not more than 10% with the belt filter operating at its maximum guaranteed capacity.		
8.03.00	Power Cycle Piping		
	(i)	Actual hanger readings under cold and hot condition (at rated parameters) to match with those of design cold and hot hanger readings for MS/CRH/HRH/HP & LP bypass piping system.	
8.04.00	Passenger & Goods Elevator for each Steam Generator & Passenger elevator for each ESP/VFD Control room:	Over load tests, travel and hoist speed checks.	
8.05.00	Mill Reject System		
	Continuous effective discharge and conveying at the rated capacity of the mill rejects without spillage or blockage in the system.		
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8.06.00	Fuel Oil Handling & Storage System (i) All Fuel Oil and LDO unloading pumps shall be guaranteed for capacity and total dynamic head either in isolation or during parallel operation. (ii) Entire piping and supports for smooth and stable operation			
8.07.00	Equipment Cooling Water System (i) Vibration, parallel operation and noise level of all the pumps at the rated duty point shall be demonstrated at site. (ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.			
8.07.01	Air Compressors and Air drying Plant (i) Capacity and discharge pressure of air compressors (ii) Parallel operation of air compressor shall be demonstrated at site. (iii) Pressure drop across Air Drying Plant. Capacity and outlet dew point of each air drying plant shall be demonstrated at site. (iv) Vibration level and noise level of each air compressor, blowers and any other rotating equipments of each air drying plant shall be demonstrated at site. (v) Power consumption of each ADP (if applicable) shall be demonstrated at site.			
8.08.00	Electrical System As applicable and/or as specified in the technical specification in Electrical Sub-section.			
8.09.00	Control & Instrumentation System Requirements			
8.09.01	Performance Requirement of the Closed Loop Control System The functions of closed loop control systems (except for those included under Contractor's scope) shall be implemented in Employer's BOP C&I Part of DDCMIS. BOP C&I part of DDCMIS shall be designed and implemented in such a way that when the control loops are in auto mode, the unit parameters are kept within preset limit in all regimes of operation (i.e. steady state conditions, ramp load change at various rates, step load change etc.) The important parameters for which the deviations have to be kept within permissible limits include throttle pressure, SH temperature, RH temperature, etc. The typical unit operating conditions under when the closed loop control systems have to keep the above mentioned parameters within permissible limits are listed in the Table No.1 at the end of this Clause.			
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	Contractor shall indicate the best achievable deviation figures for each of the above mentioned parameters for all the operating conditions in Table No.1. Further, the Contractor's DDCMIS part, the BOP C&I part of DDCMIS shall properly be integrated to achieve the permissible limits to be filled in by the Contractor in Table No.1. All required interfacing requirements etc. shall be provided by the Contractor for enabling this integration of the total plant C&I and achieving the performance requirements. Performance guarantee tests in this regard shall be carried out at site to verify the integrated performance of the total plant C&I and to verify as to whether the above mentioned important parameters remain within permissible limits under all the operating conditions. In case during this tests or otherwise it is observed that the behaviour/response of Contractor's system (drives actuators/valves etc.) is not satisfactory/acts as a limitation/restriction in achieving the permissible limits, the Contractor shall carry out all required modifications, rectifications etc. in this systems without any price repercussions whatsoever so that the permissible limits can be achieved. Contractor shall depute his experts for associating in the above tests and also for carrying out the necessary modifications, rectifications etc. in Contractor's equipment and Control systems. In case the Contractor feels that some specific requirements are to be met by the BOP C&I contractors, then the same has to be clearly brought out in the offer. (For example the loop reaction time is specified as 500 m sec. in BOP C&I specification). PERFORMANCE REQUIREMENTS FOR CLOSED LOOP CONTROL SYSTEM (TABLE – 1) <table><tr><th rowspan="2">Sl.No.</th><th rowspan="2">Load/ Rate of load change (% of MCR per min.)</th><th colspan="6">MAXIMUM DEVIATION OF PARAMETERS FROM SET POINT</th></tr><tr><th>Throttle Pressure Deviation (Kg/cm²)</th><th>Flue Gas Oxygen Deviation (% O₂)</th><th>Furnace Pressure Deviation (mmwcl)</th><th>S.H. steam Temp. Devia- tion (Deg.C)</th><th>R.H. Steam Temp. Devia- tion (Deg.C)</th><th>Drum Level mm**</th></tr><tr><td>A.</td><td>Steady State Condition</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>1.</td><td>90% to 100%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>2.</td><td>60%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>B.</td><td>RAMP Test (Change For Max. Duration of Five Minutes)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>3.</td><td>± 3%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4.</td><td>± 5%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>5.</td><td>± 10%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>C.</td><td>Step Load Changes</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>From 100% to 80% at the rate of 100% per min.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	Sl.No.	Load/ Rate of load change (% of MCR per min.)	MAXIMUM DEVIATION OF PARAMETERS FROM SET POINT						Throttle Pressure Deviation (Kg/cm ²)	Flue Gas Oxygen Deviation (% O ₂)	Furnace Pressure Deviation (mmwcl)	S.H. steam Temp. Devia- tion (Deg.C)	R.H. Steam Temp. Devia- tion (Deg.C)	Drum Level mm**	A.	Steady State Condition							1.	90% to 100%							2.	60%							B.	RAMP Test (Change For Max. Duration of Five Minutes)							3.	± 3%							4.	± 5%							5.	± 10%							C.	Step Load Changes								From 100% to 80% at the rate of 100% per min.								
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8.09.02	Notes 1. Sufficient time shall be allowed as setting period between conducting the tests. 2. Plant operating condition, i.e. main equipment status, availability of auxiliaries, operational and equipment constraints, which can influence the test, shall also be recorded. 3. Control system shall be running in the CMC mode i.e. Boiler master, fuel flow, air flow, feed water and turbine load control shall be in automatic mode Load set point, maximum and minimum load set point, rate of raise/lower of load shall be set through the CRT, Keyboard/conventional console. 4. ** For Drum Type Boiler Only (a) The following parametric tests shall also be conducted under worst case loading conditions (which is basically equivalent to a trip condition - details of which shall be as approved by Employer during detailed engineering. (i) For control system - CPU loading, Cycle time/controller reaction time and memory spare capacity (ii) For MMIPIS - CPU loading, spare duty cycle, spare memory Capacity (iii) Spare duty cycle for system bus (iv) Various display response time (v) System accuracy (vi) CRT update time (b) For the parametric test, the following requirements shall be met (i) Processor Spare Duty Cycle (Free Time) - Under worst case loading of MMIPIS and system bus each MMIPIS processor shall have 40% free time when measured over any two second period and 50% free time when measured over any one minute period. - Under worst case loading conditions of control system control system processor shall have 20% free time when measured over any one minute period.			
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	(ii) System Bus Spare Duty Cycle (Free Time). The Bidder shall furnish all necessary data to fully satisfy the Employer that the processor spare duty cycle figures quoted by the Bidder are realistic and based on configuration and computation capability of the offered system and these shall be actually achieved in the fully implemented system as commissioned at project site.. The system bus shall have min. 50% free time during the worst case loading conditions of control system, MMIPIS and the system Bus, measured over any 2 seconds interval (iii) Display Response Time The system shall acknowledge all operator requests in one of the following manner within one second of pressing of the last button : Commencement of the requested display OR Acknowledgment of operator request in a suitable manner. The display response time as defined above, under the worst case loading conditions shall not be worse than the following: <table><tr><td>All control related displays</td><td>1 sec</td></tr><tr><td>Point Details Display(single point)</td><td>1-2 secs</td></tr><tr><td>Bar chart display (20 points, current data)</td><td>2-3 secs.</td></tr><tr><td>Operator guide/plant start-up guide message display (full screen of alphanumeric information and a maximum of ten numbers of dynamic data items)</td><td>1-2 secs.</td></tr><tr><td>Plant mimic display of fair complexity with a minimum of 120 numbers of dynamic data items e.g., values, macros, line segment, etc.</td><td>2-3 secs.</td></tr><tr><td>Group review display (current values of twenty points)</td><td>2-3 secs.</td></tr><tr><td>X-Y plot display (2 X-Y- plots and a single display requiring both historical as well as current data)</td><td>3-4 secs.</td></tr><tr><td>X-T plot display (Trend of 6 analog points and a single display requiring both historical as well as current data)</td><td>3-4 secs.</td></tr><tr><td>Plant Summary display (e.g., bad point summary, limit check removed point summary. Assume the whole data base search is required and the summary display contains ten points only).</td><td>3-4 secs.</td></tr></table>				All control related displays	1 sec	Point Details Display(single point)	1-2 secs	Bar chart display (20 points, current data)	2-3 secs.	Operator guide/plant start-up guide message display (full screen of alphanumeric information and a maximum of ten numbers of dynamic data items)	1-2 secs.	Plant mimic display of fair complexity with a minimum of 120 numbers of dynamic data items e.g., values, macros, line segment, etc.	2-3 secs.	Group review display (current values of twenty points)	2-3 secs.	X-Y plot display (2 X-Y- plots and a single display requiring both historical as well as current data)	3-4 secs.	X-T plot display (Trend of 6 analog points and a single display requiring both historical as well as current data)	3-4 secs.	Plant Summary display (e.g., bad point summary, limit check removed point summary. Assume the whole data base search is required and the summary display contains ten points only).	3-4 secs.
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8.09.03	The response time for screen update after the execution of the control command from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be two seconds (excluding the drive actuation time). (iv) System Accuracy Requirements The overall system accuracy from signal input terminals to output presentation on CRT display and printers for the least accurate input range and maximum scan rate shall be not worse than +/- 0.1% of full scale of the engineering process range. For this purpose, the number of decimal places on CRT display for testing purpose shall be sufficient to cover 0.01% of full scale range. (v) CRT Updated Rates All CRT displays shall be updated at least every two seconds. (vi) The spare capacities of working and bulk memory shall meet the requirements indicated in Section-VI, Part-B, Sub-section-DDCMIS.	Availability Tests The Contractor shall guarantee 99.7 percent system availability for a continuous period of 180 days. An availability guarantee test shall be conducted to assure this level of availability. If the accrued down time exceeds 0.3 percent of 180 days, during availability test run, a new 180 days test run shall start at the time when the system becomes available again. Loss of availability (unavailable system) shall be defined as the loss of the system's guaranteed accuracy and repeat ability or of any system function, except however, that the loss of a function for not more than five percent of the points shall not be considered loss of availability. Loss of a function for not more than five percent of the points shall be treated as partial unavailability and the corresponding outage time shall be weighted with respect to the function and the percentage of the points for which the function is unavailable. Loss of each function shall have one weighing factor and unavailability of each equipment, peripheral device or process I/O card etc. shall have another weighing factor. The guaranteed accuracy and repeat ability and system parametric requirements specified in clauses on system parametric requirements shall be maintained for the entire 180 days run without any manual recalibration or any other changes made to the DDCMIS. Downtime shall start upon loss of a system function and shall end upon full restoration of the affected system function. A minimum of one hour's down time shall be charged for each loss of availability in determining system availability. The Bidder shall submit the Availability Test procedure for Employer's approval. The details regarding outage time, weighing factors for various system functions equipments to calculate the down time, test duration etc., shall be discussed and finalised during detail engineering.		
	8.09.04	The operating capabilities of the plant as listed out in Operating capabilities of Plant and equipment in Part-B, Section-VI of technical Specifications shall also be demonstrated along with other parameters/ capabilities specified under category-III		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI FUNCTIONAL GUARANTEE	PAGE 24 OF 32

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8.10.00	guarantees. The treatment of these operating capabilities of compliance/ non-compliance shall be the same as given to other Cat.-III guarantees.												
9.00.00	For all other equipment included in the scope of supply of the bidder but not covered above, the demonstration tests to be carried out shall be mutually finalised between contractor & Employer after award of contract. MAJOR REQUIREMENTS/ METHOD OF STEAM GENERATOR EFFICIENCY TESTS (i) Test Code : As per BS EN 12952-15:2003 (By loss method and based on GCV of coal) (except for specific requirements brought out herein) (ii) Test Loads : 100% TMCR (500 MW unit Load) : 80% TMCR (400 MW unit Load) (iii) Test Conditions : Boiler operating with rated excess air, coal fineness and firing blended design coal. (iv) Ambient air condition : 27 Deg.C. temperature (Dry bulb) and 60% relative humidity. The reference air temperature for the efficiency guarantee/ testing shall be taken as temperature of air (i.e. 27 Deg.C.) entering PA and FD fans. (v) No. of readings : Two sets of consistent readings for each of test loads. Average of the test efficiencies based on above two readings for each load shall be considered for guaranteed efficiency. (vi) Measurement and computation of heat losses will include but not be limited to the following: <table><tr><th>S.No.</th><th>Losses to be measured</th><th>Remarks</th></tr><tr><td>1.</td><td>Flue gas losses including Dry gas loss, Loss due to hydrogen in fuel, Loss due to moisture in fuel, Loss due to moisture in air</td><td>As per CL.8.3.3.2 of BS EN 12952-15:2003</td></tr><tr><td>2.</td><td>Loss due to unburnt carbon</td><td>Ash samples to be collected from the furnace bottom hoppers, Air heater, economizer and ESP hoppers, duct hopper (if applicable). The ash collection rate for computation of losses shall be 20%, 3%, 5%, in the furnace</td></tr></table>				S.No.	Losses to be measured	Remarks	1.	Flue gas losses including Dry gas loss, Loss due to hydrogen in fuel, Loss due to moisture in fuel, Loss due to moisture in air	As per CL.8.3.3.2 of BS EN 12952-15:2003	2.	Loss due to unburnt carbon	Ash samples to be collected from the furnace bottom hoppers, Air heater, economizer and ESP hoppers, duct hopper (if applicable). The ash collection rate for computation of losses shall be 20%, 3%, 5%, in the furnace
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BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI FUNCTIONAL GUARANTEE	PAGE 25 OF 32									

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	bottom hopper, air heater, economizer / duct hoppers (if applicable) balance in ESP hopper. The unburnt carbon loss for guaranteed Steam Generator efficiency at each load shall be taken as at least 1.0% or actual, whichever is higher. 3. Radiation loss As per Cl.8.3.3.6 of BS EN 12952-15:2003 4. Loss due to carbon monoxide (CO) in flue gas As per Cl. 8.3.3.3 of BS EN 12952-15:2003 5. Loss due to sensible heat in ash To be computed based on the ash collection rates indicated at (5) above and ash temperature of furnace bottom ash as 1040°C. Temperature of Duct / economiser ash, Air heater hopper ash, ESP ash shall be same as that of flue gas in these areas. 6. Loss due to radiation from To be worked out based on furnace bottom furnace bottom hopper opening and heat flux in these area. 7. Loss due to Mill Rejects The total mill rejects throughout of the test (minimum four hours) from all mills shall be considered as one gross which will be weighed to workout the reject rate and then reduce by halving and quartering to the required sample size for calorific value analysis to be used for working out loss due to mill rejects. 8. Losses due to external cooling As per Cl.8.3.3.5 of BS EN 12952-15:2003 (vii) The guaranteed Steam Generator efficiency shall be without any heat credit. (viii) The Steam Generator efficiency shall be guaranteed based on ambient air temperature of 27 Deg. and relative humidity of 60%. (ix) Correction to tested efficiency shall be applicable for variation in following parameters only: (a) Ambient air temperature (b) Relative humidity of ambient air (c) Hydrogen in coal. (d) Moisture in coal.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI FUNCTIONAL GUARANTEE PAGE 26 OF 32

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	(e) GCV of coal. (f) Percentage of ash in coal. (g) Heat output of steam generator. (h) Agreed final feed water temperature. (x) The duration of the test shall be at least four hours. No soot blowing shall be allowed during the test period or during stabilization period of four hours prior to commencement of the test. (xi) The Bidder shall furnish the correction curves, for Employer's approval covering the expected ranges of variations for all these parameters for the range of coal specified. (xii) For all other aspects, not spelt out above, or in the specifications, where BS code stipulates the agreement between the parties concerned before commencement of the test, the Bidder shall get these approved by the Employer. (xiii) The number, location, type and accuracy of the test grade thermocouples and pressure gauges shall be to Employer's approval. (xiv) The Steam Generator efficiency testing shall be carried out with any combination of mills in operation to Employer's choice, with fineness of pulverized coal not exceeding 70% through 200 mesh. (xv) Steam generator efficiency shall be with guaranteed or actual air heater leakages, whichever is higher.			
10.00.00	MAJOR REQUIREMENTS FOR COAL PULVERISER WEAR PART WARRANTY			
10.01.00	The Contractor shall warrant the wear life of all wear parts of the coal pulveriser when grinding the specified range of coal(s). Pulveriser wear parts are defined as those parts of the pulveriser which are in contact with coal or coal dust and are likely to wear out during the operation of the pulveriser. The guarantee/warranty shall be demonstrated on each pulveriser during the Guarantee Trial Period (GTP) commencing after establishing successful operation of the pulveriser continuously for a period of not less than twenty four (24) hours, at or near its warranty rated capacity. The GTP for the respective wear part(s) shall be at least three years or the wear life of that wear part(s), whichever occurs later. The establishment of the warranty will be based on equivalent running hours of the pulveriser regardless of the specified coal. The average wear life (AWL) of the mill wear parts during GTP shall, however be corrected for the variation in YGP index for the coal fired during GTP.			
10.02.00	Minimum Guaranteed Life for various coal pulveriser wear parts shall be as indicated in clause no. 12.05.14 Sub section-II:M-1, Part-B, Section VI.			
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10.03.00	The wear parts shall be considered to have passed their warranted operating life when they have successfully demonstrated their capability to meet the full load rated capacity of the pulveriser (as per requirements of relevant Clauses of, Part-B, Section VI of Technical Specification) during the guaranteed life of the wear part. No weld buildup or reversing of grinding elements will be permitted for achieving the guaranteed wear life. In case any of the wear part has worn out to such an extent that either the normal or safe operation of the pulveriser is jeopardized if this part is not replaced/repared, or continuous use with this part may lead to exposure or wear of other parts which are not meant for the purpose of checking the shortfall in wear life, even if there is no reduction in pulveriser rated capacity, then the part shall be deemed to have outlived its wear life. The rated capacity of pulveriser is defined in Part-B, Section-VI of Technical Specification. If any of the wear parts fail to meet the warranted life, additional quantities of these wear parts shall be supplied on pro-rata basis as defined in Clause 10.07.00 below.			
10.04.00	Computation of Credit for 3 years GTP For the duration of this warranty period, the replacement wear parts shall be available to the Employer at the spare part price indicated in the Contract, adjusted as per terms and conditions of the Contract. For wear parts that do not fulfill warranty requirements, credit shall be provided at the end of GTP to the Employer at the rate of one and a half times the shortfall worked out on item wise pro-rata basis. For example should an individual wear part or set of wear parts taken together have a price of Rs.10,000 (Rupees ten thousand) and any of the wear part or any part of wear parts set that failed to meet the warranty test lasts only 6000 hrs, a credit of 1.5 times of 2000 hrs out of guaranteed 8000 hrs or Rs.(10000x1.5x2000)/6000 would apply towards Employer and shall be provided by the Contractor. This credit shall be worked out for each replaced wear part/wear part set, throughout the GTP. This credit shall apply to all the affected mandatory spare parts purchased under original Contract.			
10.05.00	Computation of Liquidated Damages for remaining plant life On the expiry of GTP (minimum 3 years), deficiency in the life of each wear part that has not fulfilled the warranty will be worked out on an item wise basis and shortfall so established due to reduced wear life and its implications for the remaining plant life shall be worked out. The contractor at no extra cost to the Employer shall provide one and half times the wear parts needed to make good the shortfall in the wear life during the plant operation period of 22 years from the successful completion of GTP or the remaining of 25 years of plant life period after completion of GTP for the respective wear part.			
10.06.00	The shortfall part settlement (SPS) will be calculated based on the actual wear life at the parts that have worn-out in the GTP on a pulveriser-by-pulveriser basis. In this connection the procedure given in below in clause 10.07.00 shall be followed.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI FUNCTIONAL GUARANTEE	PAGE 28 OF 32

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10.07.00	Pulveriser Warranty Shortfall Part Settlement (SPS) Procedure (With Example): For all wear parts of each vertical coal pulveriser : <table><tr><td>S.N</td><td>Description</td><td>Procedure</td><td colspan="2">Example</td></tr><tr><td>(i)</td><td>Guaranteed wear life of wear part (say X hours)</td><td></td><td colspan="2">X=15000 Hrs.</td></tr><tr><td>(ii)</td><td>Total life achieved by failed wear part for similar parts 1&2 (say X1 & X2 hours)</td><td></td><td>X1=12000 Hrs X2=13000 Hrs</td><td>Life of wear parts replaced during 3 years guarantee trial period(GTP)</td></tr><tr><td>(iii)</td><td>Average wear life (AWL) of failed wear part</td><td>$AWL= \frac{X1+X2}{2}$</td><td>$AWL= \frac{12000+13000}{2}$</td><td></td></tr><tr><td>(iv)</td><td>Short fall in Hrs</td><td>$S=(X-X1)+(X-X2)$</td><td>$(15000-12000)+(15000-13000) = 5000$</td><td>Total shortfall for wear part during3 year GTP.</td></tr><tr><td>(v)</td><td>Shortfall part settlement (SPS)</td><td>$= \frac{S \times (25-GTP)}{AWL \times GTP}$</td><td>$\frac{5000 \times (25-3)}{12500 \times 3}$ $= 2.93 = 3.0$</td><td>To be rounded off to next higher whole number</td></tr></table>				S.N	Description	Procedure	Example		(i)	Guaranteed wear life of wear part (say X hours)		X=15000 Hrs.		(ii)	Total life achieved by failed wear part for similar parts 1&2 (say X1 & X2 hours)		X1=12000 Hrs X2=13000 Hrs	Life of wear parts replaced during 3 years guarantee trial period(GTP)	(iii)	Average wear life (AWL) of failed wear part	$AWL= \frac{X1+X2}{2}$	$AWL= \frac{12000+13000}{2}$		(iv)	Short fall in Hrs	$S=(X-X1)+(X-X2)$	$(15000-12000)+(15000-13000) = 5000$	Total shortfall for wear part during3 year GTP.	(v)	Shortfall part settlement (SPS)	$= \frac{S \times (25-GTP)}{AWL \times GTP}$	$\frac{5000 \times (25-3)}{12500 \times 3}$ $= 2.93 = 3.0$	To be rounded off to next higher whole number
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10.08.00	The Contractor shall provide to NTPC either the wear parts of original or better quality material in number equivalent to one and a half times the quantity worked out based on the method explained in the above example so as to compensate for the shortfall in wear life for a plant life of 25 years as has been established above, or the cost of such number (i.e. one and half times the quantity worked out as per the above example) of wear parts based on the prices agreed for mandatory spares. The final mode of compensation for such shortfall viz by means of additional quantities of spares worked out or by cost thereof shall be as per employer's discretion. The total cost of such replacements shall be without any limit to the maximum amount recoverable subject to the provisions of Clause 3.00.00 note (iv) of this Sub-Section.																																	
10.09.00	Average Wear Life (AWL) during GTP, to be considered for pulveriser wear part warranty shall be as arrived at from the station record for each pulveriser, and as corrected for variation in YGP index of the coal being fired during GTP. For this purpose the coal YGP shall be the average tested value during GTP. The Contractor shall collect the coal samples and get them tested for YGP index at recognized, Employer's approved test lab, periodically. (The frequency of sampling and testing shall be mutually agreed between Contractor & Employer). The YGP index testing shall be done as per the BS Standard specified. A jointly signed record shall be maintained during GTP.																																	
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
11.00.00 11.01.00 11.02.00	METHOD OF COMPUTING TEST EFFICIENCY OF ESP. The performance test on electrostatic precipitator will commence after a minimum period of three thousand (3000) hours of continuous operation after completion of initial operation. During the interval between the commencement of initial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performance tests. The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and allowing the normal operation of the unit including rapping and normal soot blowing and/or when fuel oil is being fired in the igniters and/or warm up guns. The overall test efficiency and test temperature/inlet dust burden for one set of ESPs serving one Steam Generator shall be worked out as follows:- a) Vm (guarantee point test flow) shall be the total of inlet gas flows to the four gas streams at the time of test. b) Test inlet dust burden (Di) shall be weighted mean of the inlet dust burdens for the individual streams i.e.: $Di = \frac{(Vm1 \times Di1) + (Vm2 \times Di2) + (Vm3 \times Di3) + (Vm4 \times Di4)}{(Vm1 + Vm2 + Vm3 + Vm4)}$ Similarly the test outlet dust burden (D0) will be calculated based on outlet gas flow. c) The weighted test inlet gas temperature (Ti) shall also be worked out in a similar manner i.e. $Ti = \frac{(Ti1 \times Vm1) + (Ti2 \times Vm2) + (Ti3 \times Vm3) + (Ti4 \times Vm4)}{(Vm1 + Vm2 + Vm3 + Vm4)}$ d) The measured test efficiency shall be : $Em = \frac{Di - Do}{Di} \times 100 (\%)$ e) The corrections for the flue gas flow and ESP inlet flue gas temp. in excess of the values for these parameters under guarantee point conditions, shall be allowed only in case and to the extent such variations are caused solely due changes in specified coal properties and ambient conditions. Further, the corrections for the flue gas flow and temperature lower than the guarantee point values shall be applied based on actually measured test values.			
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
11.03.00	Subject to the above, the corrections for the variations in gas flow, gas temp. and inlet dust burden shall be based on the computed test values and the procedure indicated in the next para. At the time of performance testing if the inlet flue gas conditions are not consistent with the specified conditions, due to variation in coal characteristics from the design blended coal and boiler operating conditions the precipitator performance conforming to this specification, shall be determined using performance curves and correction factors accepted at the time of award of contract. However no correction shall be admissible for variation in ESP inlet parameters other than the extent to which the variations are due to ambient /coal characteristics. However, the test efficiency shall be corrected to guarantee point conditions indicated in Part-B of Technical Specifications in the following manner: 1. $E_g = 1 - e^Y$ Where $Y = (V_m/V_g)^{0.5} \ln (1-E_m)$ E_g = Measured test efficiency corrected to the specified guarantee point flow only to the extent variation is due to ambient air condition/coal characteristics. V_g = Specified Guarantee point gas flow (m³/sec) V_m = Measured gas flow (m³/sec) E_m = Measured test efficiency $\ln$ = Logarithm, natural base. 2. $E_c = 1 - e^Z$ Where E_c = Corrected test efficiency to guarantee point conditions. $Z = C \cdot \ln (1-E_g)$ and $C = \frac{1}{Ca \cdot Cb \cdot Cc \text{ etc.}}$ Ca.Cb.Cc etc. = Correction factor for flue gas at temperature, inlet dust loading, sulphur, sodium contents of coal ash based on correction curves furnished by the bidder subject to owner's approval. The correction curves should be realistic for expected range of operation and variation in characteristics specified. The test efficiency shall be the average of at least three corrected test efficiencies.			
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CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
11.04.00	The Performance tests shall be carried out in accordance with method-17 of EPA (Environmental Protection Agency of USA) code. The details of the test shall, however be mutually agreed upon between the employer and the contractor.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI FUNCTIONAL GUARANTEE	PAGE 32 OF 32	

CLAUSE NO.	LIST OF MANDATORY SPARES 			
1.00.00	GENERAL The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and Recommended spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:			
1.01.00	MANDATORY SPARES a) The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by**) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings. c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly. d) The Employer reserves the right to buy any or all the mandatory spare parts. e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. f) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments. g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.			
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CLAUSE NO.	LIST OF MANDATORY SPARES 			
1.02.00	RECOMMENDED SPARES a) In addition to the spare parts mentioned above, the Contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Forms & Price Schedules. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment. b) Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.			
1.03.00	START-UP & COMMISSIONING SPARES a) Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Plant is handed over to the Employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.			
1.04.00	The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:			
2.00.00	The Contractor shall indicate the service expectancy period for the spare parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.			
3.00.00	All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccator packs as necessary.			
4.00.00	All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.			
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
5.00.00	The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares.			
6.00.00	Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.			
7.00.00	All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.			
8.00.00	The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/equipments covered under the Contract and will further ensure with his vendors that the Employer, 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.			
9.00.00	The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.			
10.00.00	In addition to the recommended spares listed by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.			
11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.			
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
1.00.00	STEAM GENERATOR & AUXILIARIES		
	PRESSURE PARTS		
	(A) Economiser		
	1. Straight Tube	600 Mtr. total for each size, type, thickness & material	
	2. Coil end bends	80 Nos. of each size, type, thickness, radius & material.	
	(B) Water Wall		
	1. Straight tube/Spiral tube	300 m total qty. for each type, thickness, size and material.	
	2. Bends for Burner elevation	16 Nos. for each size, type, thickness, radius and material	
	3. Screen water wall tube (if applicable)	100m including all types, size & material	
	(C) Low Temperature Super Heater (LTSH)		
1. Straight tube of 8-10 m length	600 mtr. total for each size, thickness, types & material		
2. Bends	80 Nos. of each size, type, thickness, radius and material.		
(D) Intermediate Temperature Superheater (ITSH)/Platen SuperHeater			
1. Straight tube of 8-10 m length	200 m of each size, thickness, type & material		
2. Bends	20 nos. of each size, thickness, radius, type and material		
3. Male & Female couplings spacers	2 Sets **		
4. Dissimilar joint spot pcs.	50 Nos.		
(E) High Temperature Superheater (HTSH) / Final Superheater			
1. Straight tube of 8-10 m length	150 mtr. of each size, thickness, type & material		
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CLAUSE NO.	LIST OF MANDATORY SPARES 		
1.00.01	2. Bends 15 nos. of each size, thickness, type, radius & material 3. Male & Female couplings spacers 2 sets ** 4. Dissimilar joint spot pcs. 50 Nos.		
	(F) Reheater		
	1. Straight tube of 8-10 m length 200 metre each of size thickness, type & material		
	2. Bends 15 Nos. of each size, thickness, type, radius & material		
	3. Male & Female couplings spacer 2 sets **		
	4. Dissimilar joint spot pcs. 50 Nos.		
	Spares for Header		
	(A) Water wall Header		
	(I) Hand hole plate 2 nos.		
	(ii) Yoke plate with fasteners 2 sets *		
1.00.02	(B) Spares for Superheater Header		
	(i) Radiographic plug 4 nos.		
	(C) Spares for Reheater Header		
	(i) Hand hole plate assembly 2 nos. of each type		
	(ii) Radiographic plug 4 nos.		
1.00.02	Superheater / Reheater Attenuation System		
	1. Desuperheater liner 2 sets of each type		
1.00.03	Steam Drum (For Drum Type Boiler)		
	1. Manhole gasket for Drum 6 nos.		
	2. Local water level gauge class assembly 1 set **		
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CLAUSE NO.	 LIST OF MANDATORY SPARES		
1.00.04	3. Spares for direct water level gauge (Repair kit for above such as port assembly, glass strip lamps spring cones, gaskets etc.) 1 set ** 4. Spares for remote level indicator (Repair kit such as seal ring bull deflector plate, gasket, diaphragm etc.) 1 set ** 5. Spare isolating valve assembly for above gauge glass 1 set **		
	Steam Generator water circulation pump (as applicable)		
	1. Motor stator winding	Nil	
	2. Journal bearing	1 set *	
	3. Thrust bearing	1 set *	
	4. Casing wear rings	2 sets *	
	5. Impeller wear rings	2 sets *	
	6. Set of gaskets	2 sets * (all gaskets including heat exchanger)	
	7. Set of 'O' rings	3 sets *	
	8. Gland packings	3 sets *	
	9. Motor heat exchanger	1 set *	
	10. Thermocouples	1 set *	
	11. Temp. switches	1 set *	
	12. Pressure switches	1 set *	
	13. Flow switch	1 set *	
	14. Transmitters	1 no. of each type	
	* One set means one complete replacement of one equipment (for all above clause)		
	** On set means for one steam generator unit (for all above clauses)		
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
1.03.00	Fans			
	(A)	ID Fans (Radial)		
	1	Impeller liners	1 set	
	2	Casing liners	1 set	
	3	Motor bearings	2 sets	
	4	Fan bearings	2 sets	
	5	Seals, 'O' rings Oil rings for all the Fan bearings.	4 sets	
	6	Lube Oil System		
	6.1	Pump assembly	2 nos.	
	6.2	Motor	2 nos.	
	6.3	Pressure regulator	2 nos.	
	6.4	Filters	4 nos.	
	6.5	Coupling between oil pump & motor	2 nos.	
	7	IGV	1 set	
	(B)	FD Fans		
	1	Fan bearings	2 sets	
	2	Motor Bearings	2 sets	
	3	Fan Blades	2 sets	
	4	Spares for blade bearing Assembly		
	4.1	Bearings	2 sets	
	4.2	'O' rings	2 sets	
	4.3	Bushes	2 sets	
	4.4	Metallic rings	2 sets	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 7 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
	4.5	Intermediate piece (if applicable)	2 sets	
5		Lube Oil system		
	6.1	Pump assembly	2 nos.	
	6.2	Motor	2 nos.	
	6.3	Pressure regulator	2 nos.	
	6.4	Filters	4 nos.	
	6.5	Coupling between oil pump & motor	2 nos.	
6		Couplings between fan & motor	1 nos.	
7		Hydraulic servomotor	2 nos.	
(C)		PA Fans		
	1.	Fan Bearings	2 sets	
	2.	Motor Bearings	2 sets	
	3.	Coupling between fan & motor	2 nos.	
	4.	Fan blades	2 sets	
	5.	Spares for blades brg. Assembly		
	5.1	Bushes	2 sets	
	5.2	Bearings	2 sets	
	5.3	'O' rings	2 sets	
	5.4	Metallic rings	2 sets	
	5.5	Intermediate piece (if applicable)	2 sets	
6.		Lube Oil System		
	6.1	Pump assembly	2 nos.	
	6.2	Motor	2 nos.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-VII LIST OF MANDATORY SPARES
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CLAUSE NO.	LIST OF MANDATORY SPARES			एन टी पी सी NTPC
1.04.00	6.3	Pressure regulator	2 nos.	
	6.4	Filters	4 nos.	
	6.5	Pump & motor coupling	2 nos.	
	8.	Hydraulic Servomotor	2 nos.	
	Note : In Clause 1.03.00 (A), (B) & (C) above, one set means one Complete replacement of one fan			
	Coal Pulverizers			
	1.	Grinding elements		
	(a)	Rollers/tyres/grinding balls.	4 sets	
	(b)	Bull ring segments/ bowl / rings	4 sets	
	Note : One set of grinding element at (a) & (b) above is defined as under :			
1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 XN)/GWL rounded off to nearest higher whole number).				
Where :				
GWL = Guaranteed wear life of grinding element (a) & (b) as offered by the bidder.				
N = Number of mills installed for one Steam generator unit.				
	2.	Gear box internals (except bearings & seals)	4 sets *	
	3.	Bearings	2 sets *	
	4.	Seals & rings	2 sets *	
	5.	Mill motor Bearings	2 sets *	
	6.	Liners with brackets & fasteners	3 sets *	
	7.	Discharge valve assembly	3 sets *	
	8.	Multiport outlet & liners	4 sets *	
	9.	Mill main shaft/yoke	1 no.	
	10.	Journal & Spring	9 nos.	
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
1.05.00	11.	Hyd. Loading cylinder	2 nos.
	12.	Filter Cartridges	4 nos.
	13.	Actuators (complete)	1 no. of each type
	14.	Actuator spare kits	1 set of each type *
	15.	Mill Bottom	2 nos.
	16.	Bowl hub assembly/Ring seat	1 no.
	17.	Lower skirt	1 no.
	18.	Lube Oil System	
	18.1	Pump assembly	2 nos.
	18.2	Motor	2 nos.
	18.3	Pressure regulator	2 nos. for each type
	18.4	Filters	8 nos.
	18.5	Pump & Motor coupling	2 nos.
	* One set means one complete replacement of one mill.		
	Feeders		
	1.	Belt	5 sets *
	2.	Belt drive motor	4 nos.
3.	Belt drive reducer	4 nos.	
4.	Clean out conveyor motor	2 nos.	
5.	Clean out conveyor reducer	2 nos.	
6.	Counter assembly	1 no.	
7.	Head pulley assembly (complete)	1 no.	
8.	Weight sensing system		
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
1.06.00	8.1	Weighting roll	1 no.
	8.2	Weighting spare roller assembly	1 no.
	8.3	Drag link assembly	1 no.
	9.	Tension roll	1 no.
	10.	Worm	1 no.
	11.	Worm wheel	1 no.
	12.	Feeder gate	1 no.
	13.	Actuator	1 no. of each type
	* One set means one complete replacement of one feeder		
	Coal Burners/Coal Pipe Bends		
	1.	Coal compartment assembly	3 sets**
	2.	Inter air compartments	1 set **
	3.	Oil compartments/oil nozzle tips	1 set **
	4.	End air compartment	1 set **
5.	Coal nozzle castings	1 set **	
6.	Adjustable coal nozzle tips	1 set **	
7.	Coal pipe bends with liners	15 nos. for each type size, thickness & radius	
8.	Victualic couplings	15 nos. of each size	
9.	Victualic coupling gasket	20 nos. of each size	
** One set means one complete replacement for a unit			
1.07.00	Seal Air Fan		
	1.	Impeller with shaft	1 no.
	2.	Bearings & seals	2 sets *
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CLAUSE NO.	एनटीपीसी NTPC LIST OF MANDATORY SPARES		
1.08.00	3. Motor bearings 2 sets* 4. Motor 1 no. * One set means complete replacement of one fan Regenerative Air Preheater 1. Support Bearing 2 nos. 2. Guide Bearing 2 nos. 3. Lubricating system of support & Guide Brg 3.1 Pump assembly 2 nos. 3.2 Pump motor 2 nos. 3.3 Pressure regulator 1 no. 3.4 Filters 4 nos. 3.5 Pump motor coupling 2 nos. 4. Radial seals 4 sets * 5. Axial seals 3 sets * 6. Circumferential or bypass seals 2 sets * 7. Rotor post seals 3 sets * 8. Air motor 3 nos. * 8.1 Bearings & seals for air motor 2 sets * 9. Complete speed reducer 2 set * 9.1 Speed reducer gears, pinions & shaft 1 set * 9.2 Speed reducer bearings 1 set * 9.3 Speed reducer seals & gaskets 1 sets * 9.4 Speed reducer clutch assembly 2 nos. 10. Fluid coupling 3 nos. 11. Other couplings with inserts & fasteners 2 nos.		
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
1.09.00	12.	Solenoid valves	2 nos. of each type
	13.	Spare kit for rotor stoppage alarm	1 set *
	14.	Spare kit for fire sensing device	1 set *
	15.	Spare for cleaning device	
	15.1	Worm & worm wheel for gear reducer	1 set *
	15.2	Coupling	1 set *
	15.3	Bearing & seals for spec reducer	1 set *
	15.4	Bearing for cleaning device	2 sets *
	16.	Bushings for worm gear reducer	1 set *
	17.	Actuators	1 no. of each type
	18.	Cold, intermediate & hot end baskets	1 sets each type and size *
	* One set means one complete replacement of one APH.		
	Fuel Oil System		
	(A)	Heavy fuel oil system	
	1.	Fuel oil guns	2 sets *
	2.	Oil gun nozzle (with back plate, mixing plate and cap nut)	2 sets *
	3.	Oil gun flexible hoses(including for guide pipe, air line)	2 sets *
	4.	Spares for Heavy Oil Pump	
	4.1	Complete cartridge assembly	2 sets *
4.2	Mechanical seals	2 sets *	
4.3	Bearings including that of motor	2 sets *	
4.4	Set of 'O' ring & seals	2 sets *	
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
	4.5	Set of all types of bushes & sleeves	2 sets*	
	4.6	Set of gaskets	2 sets *	
	5.	Heavy oil pump relief valve complete with accessories	2 nos	
	6.	Spares for oil pump relief valve		
	6.1	Valve spindle & disc	1 no.	
	6.2	Set of gasket	1 set *	
	6.3	Sealing ring	1 set *	
	6.4	Springs	1 set *	
	7.	Burner isolation valves	12 nos. or 10% whichever is higher	
	7.1	Gaskets for above valves	1 set *	
	7.2	Gland packings for above valves	1 set *	
	8.	Heavy oil pressure control valve	2 nos.	
	9.	Heavy oil main trip valve complete	2 nos	
	10.	Atomising steam pressure reducing valve	2 nos.	
	11.	Heavy oil temperature control valve	2 nos.	
	12.	Actuators of above valves	1 no. of each type & rating	
	(B)	Light Oil System		
	1.	Light Oil gun	10% of population	
	2.	Oil gun nozzle (with back plate, mixing plate & cap nut)	2 sets *	
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
1.10.00	3.	Light Oil pump		
	3.1	Complete cartridge assembly	2 sets	*
	3.2	Mech. Seals	2 sets	*
	3.3	Bearings including that of motor	2 sets	*
	3.4	Set of 'O' rings & seals	1 set	*
	3.5	Set of all types of bushes & sleeves	2 sets	*
	3.6	Set of gaskets	1 set	*
	* One set means one complete replacement of one equipment.			
	HEA Ignitors			
	1.	HEA retractor	2 sets	*
	2.	HEA spark rod	2 sets	*
	3.	HEA spark tip	2 sets	*
	4.	HEA exciter	4 nos. of each type and rating	
	5.	Solenoid valves	-do-	
	6.	Limit switch	4 nos. of each type and rating	
	7.	Solenoid valve coil	8 nos. of each type and rating	
	8.	HEA spark gap	8 nos.	
	9.	HEA Transformer	8 nos.	
	10.	HEA rectifier	8 nos.	
	11.	HEA inductor	8 nos.	
12.	Resistor	8 nos. of each type and rating		
13.	Capacitor	-do-		
* One set means one complete replacement of one HEA Ignitor.				
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CLAUSE NO.	एनटीपीसी NTPC LIST OF MANDATORY SPARES			
1.11.00	Soot Blowers			
	1. Complete assembly of water wall deslagger	5 nos.		
	2. Motor for water wall deslagers	10 nos.		
	2.1 5 nos. for rotary motion			
	2.2 5 nos. for traverse motion			
	3. Complete valve assembly for water wall deslagger.	5 nos.		
	4. Motor for long travel retractable soot blower.	6 nos.		
	4.1 3 nos. for rotary motion			
	4.2 3 nos. for traverse motion			
	5. Complete valve assembly for long retractable soot blower.	1 no.		
	6. Complete motor for air preheater soot blower	1 no. of each type	If separate type & rating of SB are envisaged for RAPHs, then 1 No. of each type.	
	7. Reduction gear box & motor for air preheater soot blower oscillation	1 no. of each type	-do-	
	8. Complete valve assembly for air preheater soot blower	1 no. of each type	-do-	
	9. Bearing & oil seals for 9.1 Long retractable soot blower	2 sets *		
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
	9.2	Water wall deslagger	1 set *	
10.		Complete steam safety valve assembly	1 no.	
11.		Steam control valve assembly	1 no.	
	11.1	Stem & disc. assembly for above	2 sets *	
	11.2	Gaskets	2 sets *	
	11.3	Gland packings	2 sets *	
	11.4	Seat rings	2 sets *	
12.		Long retractable soot blower assemblies complete.	1 no. of each type	
13.		Limit switches	2 nos. of each type & rating	
14.		Complete power pack assembly for Long Retractable soot blower	2 nos.(1 no. for rotary + 1 no. for transverse)	
15.		Spare set of rotary & transverse chain for long retractable soot blowers	1 no. of each type & size	
16.		Spares for rack gear Assembly		
	16.1	Set of Gears & shaft (Spur & worm)	1 set *	
	16.2	Rack & pinion	1 set *	
17.		Thermocouples for temperature probes	1 no. of each type & size	
* One set means one complete replacement of one valve .				
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
1.12.00	VALVES			
	1.	Spares for Steam Drum/ Safety valves		
	(i)	Upper adjusting ring	2 nos. of each type	
	(ii)	Lower adjusting ring	-do-	
	(iii)	Locking pin set	-do-	
	(iv)	Safety valve disc	-do-	
	(v)	Safety valve stem	-do-	
	(vi)	Valve spindle	2 nos.	
	(vii)	Guide	2 nos.	
	2.	Spares for SH Safety Valves		
	A	SH safety valve assy	1 no.	
	B (i)	Disc	2 nos. of each type	
	(ii)	Upper adjusting ring	2 nos.	
	(iii)	Lower adjusting ring	2 nos.	
	(iv)	Valve spindle	2 nos.	
	(v)	Set of washers	2 sets of each type *	
	(vi)	Guide	2 nos. of each type	
	(vii)	Set of locking pins	2 sets of each type *	
	3.	Spares for Hot RH safety Valves		
	(i)	Disc	2 nos. of each type	
	(ii)	Upper adjusting ring	2 nos. of each type	
	(iii)	Lower adjusting ring	-do-	
	(iv)	Valve spindle	-do-	
	(v)	Set of washers	2 set of each type *	
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
	(vi)	Set of pins	2 nos. of each type
	(vii)	Guide	2 nos. of each type
4.	Spares for Cold RH safety Valves		
	(i)	Disc	2 no. of each type
	(ii)	Upper adjusting ring	-do-
	(iii)	Lower adjusting ring	-do-
	(iv)	Valve spindle	-do-
	(v)	Locking pin set	2 sets of each type *
	(vi)	Guide	-do-
	(vii)	Set of washers	2 sets *
5.	Spares for Electromatic relief valve		1 no of each type
5.1	Complete Electromatic relief valve		2 nos. of each type
5.2	Spares for above :		
	(i)	Disc for main valve	2 nos. of each type
	(ii)	Spring for main valve	-do-
	(iii)	Seal rings for main valve	-do-
	(iv)	Seal bushing for main valve	-do-
	(v)	Disc & steam assembly for pilot valve	-do-
	(vi)	Bushing for pilot valve	-do-
	(vii)	Spring for pilot valve	-do-
	(viii)	Seal ring	-do-
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CLAUSE NO.	एनटीपीसी NTPC LIST OF MANDATORY SPARES		
1.13.00	6. Spares for Superheater spray control valve		
	6.1 Spares for the above :		
	(i) Gland packings set	2 sets *	
	(ii) Pressure seal gasket	3 sets *	
	(iii) Stem	1 nos.	
	(iv) Plug valve	2 nos.	
	7. Spares for Reheater spray control valve		
	7.1 Spares for the above :		
	(i) Gland packings set	2 sets *	
	(ii) Pressure seal gasket	3 sets *	
	(iii) Stem	1 no.	
	(iv) Plug valve	2 nos.	
	1.13.00 Superheater Spray Block Valve Spares		
	1. Gland packing set	2 sets of each type *	
1.14.00	2. Pressure seal gasket	2 nos. of each type	
	3. Stem	2 nos. of each type	
	4. Valve plug	2 nos. of each type	
	1.14.00 Reheater Spray Block Valve Spares		
	1. Gland packing set	2 sets of each type *	
	2. Pressure seal gasket	2 nos. of each type	
	3. Stem	2 nos. of each type	
	4. Valve plug	2 nos. of each type	
1.15.00	1.15.00 Spares for boiler main steam stop valve		
	1. Set of gland packings	2 sets *	
	2. Pressure seal gaskets	3 nos.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES PAGE 20 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
1.16.00	3.	Stem	1 no. (1 no. for main of valve & 1 no. each for integral type bypass)	
	4.	Disc	1 no. -do-	
	5.	Seat rings	2 nos. -do-	
	6.	Fastners	1 no. -do-	
	7.	Actuator	2 nos. -do-	
	Boiler Feed Check Valve			
	1.	Body seat rings	2 nos.	
	2.	Flap	1 nos.	
	3.	Pressure seal ring	2 nos.	
	4.	Gland packings	2 sets *	
1.17.00	5.	Fastners	1 set *	
	Start up vent valve			
	1.	Stem	1 no.	
	2.	Disc	1 no.	
	3.	Body seat rings	2 sets *	
	4.	Gland packings	2 sets *	
	5.	Pressure seal rings	3 nos.	
	6.	Fastners	1 set *	
	7.	Startup vent valve assy	1 no.	
	1.18.00	Economiser Recirculation Valve (if applicable)		
1.		Valve Stem	1 no.	
2.		Disc	1 no.	
3.		Body seat rings	1 set *	
4.		Gland packings	1 set *	
5.		Pressure seal rings	2 nos.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 21 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES			एन टी पी सी NTPC
1.19.00	Auxiliary Steam Pressure Reducing & Desuperheating System			
	(1)	High Capacity PRDS System (MS)		
	1.0	Desuperheater liners	1 set *	
	(1.1)	Steam pressure reducing cum desuperheating valves		
	(i)	Stem	1 no.	
	(ii)	Disc	1 no.	
	(iii)	Body seat rings	2 nos. for each type, size and rating of valves	
	(iv)	Gland packings	2 nos. for each type, size and rating of valves	
	(v)	Pressure seal ring	3 nos.	
	(vi)	Gasket	2 nos.	
	(1.2)	Spray water line control valves		
	(i)	Valve trim including cage, plug, stem, seat rings, guide bushings, stem packing	1 no. for each size, type & rating of valves	
	(2)	Low Capacity PRDS System (CRH)		
	2.1	Steam pressure reducing valve		
	(i)	Stem	1 no.	
	(ii)	Disc	1 no.	
	(iii)	Body seat rings	2 nos. for each type/size	
	(iv)	Gland packings	2 nos. for each size, type & rating of valves	
	(v)	Pressure seal ring	3 nos.	
	(vi)	Gaskets	2 nos.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 22 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES				
1.20.00 1.20.01	(2.2)	Spray water line control Valves			
	(i)	Valve trim including cage, plug, stem, seat rings, guide bushings, steam packing	1 no. for each size, type & rating of valves		
	VFD system				
	Electrical Cards				
	1.1	Control modules	2 no. of each type & rating		
	1.2	I/O module	2 nos. of each type & rating		
	1.3	Power supply modules	2 nos of each type & rating		
	1.4	Thyristor gate module including gate transformer	110% of installed quantity		
	1.5	Exiter module	1 no.		
	2.	Thyristor bridge leg	10%		
	3.	Over voltage limiter and surge suppressor network	1 set		
	4.	Power & Control fuse	100% of installed quantity		
	5.	Control Transformer	1 no. of each type & rating		
	6.	Contactor/load break switch	1 no.		
7.	CT/VT	1 no. of each type & rating			
8.	Indicating lamps	100% of each type & rating			
9.	Auxiliary contactors & relays	10% of installed quantity			
10.	Panel mounted meters	1 no. of each type & rating			
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC		
1.20.02	11.	Panel mounted printer	1 no.		
	12.	Parameter tuning device	1 no.		
	13	Indicating lamp holder full set	10% of each type/colour		
	14	Semiconductor fuses for thyristor	1set		
	LT Transformer (VFD)				
	(i)	(a) Primary	3 Nos. each rating		
		(b) Secondary	3 nos. each rating		
	(ii)	Winding temperature indicator with alarm & trip contacts	1 no.		
	(iii)	Oil temperature indicator with alarm & trip contacts	1 no.		
	(iv)	Magnetic oil level gauge	1 no.		
	(v)	Pressure relief device	1 no.		
	(vi)	Diaphragm for explosion vent	1 no.		
	(vii)	Buchholz relay/sudden pressure relay (as applicable)	1 no.		
	(viii)	Silca get charge	1 charge		
	(ix)	Floats with contacts for buchholz relay	1 set		
	(x)	Set of gaskets	1 set		
	(xi)	Contacts tap changer	1 set		
(xii)	Set of valves (1 no. of each size)	1 set			
(xiii)	Pressure gauge (applicable for sealed tank)	1 no. of each type			
(xiv)	Set windings for one limb in a suitable oil container	1 for each rating			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 24 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC		
1.20.03	Electrostatic Precipitator (ESP)				
	(a)	Support insulator	4 nos.		
	(b)	Shaft insulator	6 nos.		
	(c)	Emitting electrodes			
	(i)	Helical wire type	5% of the installed quantity in one set of ESPs for each SG		
	(ii)	Wire pipe in rigid frame	10% of the installed quantity in one set of ESPs for each SG		
	(iii)	Mast type	2% of the installed quantity in one set of ESPs for each SG		
	(d)	Collecting electrode	2% of the installed quantity in one set of ESPs for each SG		
	(e)	Inner arm assembly	20 nos. each for collecting & emitting system		
	(f)	Outer arm assembly	10 nos. each for collecting & emitting system		
	(g)	Plain bearing	20 nos. of each type and size		
	(h)	Shock bar/anvil	60 nos. of each type and size		
	(i)	Rappers			
	(a)	For electric rappers			
	(i)	Assembled rapper/dop rods	20 nos. of each size and type		
	(ii)	Coil assembly along with sleeve	4 nos.		
	(iii)	Casing	4 nos.		
	(iv)	Gaskets & packing	4 nos. of each size and type		
	(b)	For tumbling rappers			
	(i)	Hammers	20 nos. of each size and type		
	(ii)	Bearing components	4 nos.		
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
	(iii)	Shafts	4 nos.
	(iv)	Gear motors	8 nos.
	(j)	Transformer rectifier set	
	(a)	Complete set	1 no.
	(b)	High voltage insulator	2 nos.
	(k)	Switches and Gaskets	1 set (One set means one complete replacement for all the TR sets of one Boiler)
	(l)	Control Switch	
	(i)	Transformer-rectifier set controller	1 no.
	(ii)	Rapper controller complete	1 no.
	(iii)	Communication controller complete	1 no.
	(iv)	Electronic cards	
	(a)	For rapper controller & ESP management system	1 set
	(b)	For transformer rectifier controller	1 set
	(v)	Display unit	1 no. of each type
	(vi)	Keyboard	1 no. of each type
	(vii)	Push buttons for	
	(a)	TR set controller	2 sets
	(b)	Others	1 set
	(viii)	Indicator lamps	1 set
	(ix)	Control fuse	1 set
	(x)	Power fuse	1 set
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
1.21.00	(xi)	Thyristor fuse	1 set	
	(xii)	Thyristor of transformer rectifier controller	2 sets	
	(m)	MCC Auxiliary Control Panel		
	(i)	Breaker	1 set	
	(ii)	Power contacts	1 set	
	(iii)	Auxiliary relays	1 set	
	(iv)	Over load relay	1 set	
	(v)	Power fuse	1 set	
	(vi)	Contact fuse	1 set	
	(vii)	Control terminal block	1 set	
	FLUE GAS DESULPHURISATION SYSTEM			
	S. No.	Description	Nos. / Sets	
	1.00	Gates in Flue Gas System		
		1. Seals	1 set of each type (Set means complete replacement for one gate)	
		2. Actuator	1 no. of each type	
	2.00	Gas-Gas Heater		
	2.01	Regenerative Ljungstrom Type (if applicable)		
	1. GGH Electric Motor complete	1 no.		
	2. Support Bearing	1 No.		
	3. Guide Bearing	1 no.		
	4. Lubricating system of support & Guide Brg			
	4.1 Pump assembly	1 no. of each type		
	4.2 Pump motor	1 no. of each type		
	4.3 Pressure regulator	1 no. of each type		
	4.4 Filters	2 nos. of each type		
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
		4.5 Pump Motor coupling1 no of each type 5. Radial seals2 sets* 6. Axial Seals2 sets* 7. Circumferential or bypass seals2 sets* 8. Rotor post seals2 sets* 9. Heating Element1 set* 10. Air Motor2 nos. 11. Complete Speed reducer1 set* 11.1 Speed reducer Gears, pinions & shaft1 set* 11.2 Speed reducer Bearings1 set* 11.3 Speed reducer Seals & gaskets2 sets* 11.4 Speed reducer Clutch assembly1 no 12. Couplings with inserts & fasteners2 nos. 13. Solenoid valves2 nos 14. GGH Cleaning Device 14.1 Lance and Nozzle1 no. 14.2 Drive assembly including Gearbox and motor1 no. 14.3 Valve assembly with actuator1 no. 14.4 Pump assembly (if applicable)1 no.	
	2.02	Heat Pipe Type Heat Exchanger (If applicable)	
		1. Finned Tube20% of each type, size, thickness, material 2. Pump impeller assembly (if applicable)1 no 3. Pump Bearings1 no. of each type 4. Coupling1 no. 5. Motor1 no.	
	3.00	Absorber	
		1. Liner Material5% coverage of each material and thickness for one Unit/Absorber 2. Absorber Spray/Oxidation nozzles20% of each type 3. Absorber Mist Eliminator Washing Nozzles10% of each type 4. Absorber Mist Eliminator5% of each type	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES PAGE 28 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES			
	4.00	Oxidation Air Compressor		
	1.	Impeller Assembly	1 no.	
	2.	Bearings	1 no. of each type	
	5.00	Agitators		
	(For Absorber Oxidation Tank, Mill Separator Tank, Limestone Slurry Preparation Tank and any other tank provided with agitators)			
	1.	Impeller Assembly	1 no. of each type	
	2.	Bearing Assembly	1 no. of each type	
	3.	Motor	1 no. of each type	
	4.	Belt and Pulley (If applicable)	1 no. of each type	
	5.	Gear Box Assembly (If Applicable)	1 no. of each type	
	6.00	Slurry Pumps		
	(Absorber Slurry Recirculation Pump, Gypsum Bleed Pumps, Mill Circuit Pump, Limestone Supply Pumps and any other slurry pumps)			
	1.	Impeller Assembly	1 no. of each type	
	2.	Casing Liners	1 no. of each type	
	3.	Seals	1 set of each type	
	4.	Bearings	1 no. of each type	
	5.	Motor	1 no. of each type	
	6.	Motor-Pump Coupling	1 no. of each type	
	7.00	Hydro-cyclones		
	(Mill , Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone)			
	1.	Hydro-cyclone Isolation Valve	10% of each type	
2.	Hydro-Cyclone	10% of each type		
8.00	Feeders			
1.	Belt	2 sets *		
2.	Belt drive motor	1 nos.		
3.	Belt drive reducer	1 nos.		
4.	Speed Reducer Assembly	1 set*		
5.	Weighing Instruments	1 set*		
9.00	Limestone Mills			
1.	Mill Wear Parts (Liners)	1 sets		
Note : One set of Mill Wear Parts (Liners) above				
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 29 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC																																																																					
	is defined as under : 1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 x 1) / GWL, rounded off to nearest higher whole number. Where : GWL =Guaranteed wear life of Mill Wear Parts as offered by the bidder. <table><tr><td>2.</td><td>Mill Motor</td><td>1 no.</td></tr><tr><td>3.</td><td>Auxiliary Motor</td><td>1 no.</td></tr><tr><td>4.</td><td>Gear box internals (including Bearings and Seals)</td><td>2 sets *</td></tr><tr><td>5.</td><td>Complete Gear Box</td><td>1 sets *</td></tr><tr><td>6.</td><td>Mill motor Bearings</td><td>2 sets *</td></tr><tr><td>7.</td><td>Lube Oil / Grease System</td><td></td></tr><tr><td>7.1</td><td>Pump assembly</td><td>1 nos. of each type</td></tr><tr><td>7.2</td><td>Motor</td><td>1 nos. of each type</td></tr><tr><td>7.3</td><td>Pressure regulator</td><td>1 nos. of each type</td></tr><tr><td>7.4</td><td>Filters</td><td>2 nos. of each type</td></tr><tr><td>7.5</td><td>Pump & Motor coupling</td><td>1 nos. of each type</td></tr><tr><td>10.00</td><td>Slurry Valves</td><td>2 no. of each type</td></tr><tr><td>11.00</td><td>Slurry Line Bends</td><td>2 no. of each type</td></tr><tr><td>12.00</td><td>Vacuum Belt Filter</td><td></td></tr><tr><td></td><td>1. Filter Cloth</td><td>5 sets</td></tr><tr><td></td><td>2. Belt (if applicable)</td><td>2 sets</td></tr><tr><td></td><td>3. Vacuum Box Seals</td><td>3 sets</td></tr><tr><td></td><td>4. Drive Motor (if applicable)</td><td>1 no.</td></tr><tr><td>13.00</td><td>Vacuum Pumps</td><td></td></tr><tr><td></td><td>1. Pump Impeller Assembly</td><td>1 no.</td></tr><tr><td></td><td>2. Pump Bearing</td><td>1 set</td></tr><tr><td></td><td>3. Seals</td><td>1 set</td></tr><tr><td></td><td>4. Motor</td><td></td></tr></table>			2.	Mill Motor	1 no.	3.	Auxiliary Motor	1 no.	4.	Gear box internals (including Bearings and Seals)	2 sets *	5.	Complete Gear Box	1 sets *	6.	Mill motor Bearings	2 sets *	7.	Lube Oil / Grease System		7.1	Pump assembly	1 nos. of each type	7.2	Motor	1 nos. of each type	7.3	Pressure regulator	1 nos. of each type	7.4	Filters	2 nos. of each type	7.5	Pump & Motor coupling	1 nos. of each type	10.00	Slurry Valves	2 no. of each type	11.00	Slurry Line Bends	2 no. of each type	12.00	Vacuum Belt Filter			1. Filter Cloth	5 sets		2. Belt (if applicable)	2 sets		3. Vacuum Box Seals	3 sets		4. Drive Motor (if applicable)	1 no.	13.00	Vacuum Pumps			1. Pump Impeller Assembly	1 no.		2. Pump Bearing	1 set		3. Seals	1 set		4. Motor	
2.	Mill Motor	1 no.																																																																						
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BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES																																																																					
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CLAUSE NO.	LIST OF MANDATORY SPARES 		
	2 14.00 Vacuum Breaker Valves 1. Valve Assembly 1 no. 2. Actuator 1 no. 15.00 Sump Pumps 1. Complete Impeller Assembly 1 no. of each type 2. Casing Liners 1 set* of each type 3. Bearing 1 set* 4. Motor 1 no. of each type 5. Pump discharge valve assembly 1 no. of each type 16.00 Horizontal Centrifugal Pumps 6. Complete Impeller Assembly 1 no. of each type 7. Casing Liners 1 set* of each type 8. Bearing 1 set* 9. Motor 1 no. of each type 10. Pump discharge valve assembly 1 no. of each type Note: 1. Any change in size, material, design etc, which obviates one to one replacement of the part shall be considered a different type. * Unless otherwise stated, a set shall mean complete replacement for one equipment. 1.22.00 Elevators 1.22.01 Goods Cum Passenger Elevator 1. Friction block 2 nos. 2. Guide roller of each type 20% of total population or 3 nos. of type whichever is higher 3. Contactors of each type 2 nos. 4. Control transformer 1 no. of each type 5. Time device 2 nos. of each type 6. Rectifiers 2 nos. of each type 7. Overcurrent relay 2 nos. of each type		
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
	8.	Auxiliary relay	3 nos. of each type
	9.	Resistor	3 nos. of each type
	10.	Fuses of each rating	20% of the total population
	11.	Limit switches of each type	3 nos.
	12.	Push button	3 nos. of each type
	13.	Contact device (if applicable)	3 nos. of each type
	14.	Brake motor	2 nos. of each type
	15.	Transmitters	2 nos. of each type
	16.	Switches of each type	3 nos.
	17.	Receiver	2 nos. of each type
	18.	Bearings of each type & size	2 nos.
	19.	Roller of each type	3 nos.
	20.	Worm gear spares	
	(a)	'O' rings	3 sets *
	(b)	Sealing ring of each type	3 sets *
	21.	Spares for brake	
	(a)	Fan	2 nos. of each type
	(b)	Magnetic coil	3 nos. of each type
	(c)	Brake disc	2 sets *
	(d)	Brake pad	2 sets *
	22.	Bushing (for door front)	2 sets *
	23.	Pinion	2 nos. of each type
	** One set means one complete replacement for a unit.		
	* One set means one complete replacement for an equipment.		
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
2.00.00	EQUIPMENT COOLING SYSTEM, CHEMICAL DOZING, PLATE TYPE EXCHANGER		
2.01.00	DMCW Pumps		
	i) Impeller	Nil	
	ii) Shafts	1 No.	
	iii) Shaft Sleeve	2 Nos	
	iv) Casing wearing rings (if applicable)	1 set	
	v) Impeller wearing rings (if applicable)	1 set	
	v) Bearings for the pumps	1 Set of each type	
	vi) Motor Bearings	1 set of each type	
	vii) Thrust Bearings (if applicable)	1 set of each type & size	
	viii) Sleeve nuts and O-rings	1 set of each type and size	
	ix) Gland & Gland Packing (if applicable)	Nil	
	x) Fastners	Nil	
	xi) Complete Coupling (Pump and Motor)	Nil	
	xii) Mechanical seal (if applicable)	1 set of each type	
2.02.00	Plate Type Heat Exchangers		
	i) Gaskets	5% of total requirement of each type & size	
	ii) Fasteners	Nil	
	iii) Plates	2% each type	
2.03.00	AIR COMPRESSORS / ADP /COMPRESSOR HOUSE CRANE		
	a. H. P. Stage		
	Complete HP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve,	1 Set of each type/ rating	
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC	
	discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts. b. L. P. Stage Complete LP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts. 1 Set of each type/ rating c Motor Bearings 1 Set d LP stage Gear and Pinion 1 Set e. HP stage Gear and Pinion 1 Set f Air Intake Filter Element With Gaskets 2 Sets g Oil Filter Element With Gaskets & Seals 2 Sets g Safety Valve Springs and Gaskets for HP stage 1 Set h. Safety Valve Springs and Gaskets for LP stage 1 Set i. VALVES (within the Compressor house) WITH ACTUATORS 1 nos of each type / rating/size j. OIL PUMP/MOTOR 1 Oil Pump & Motor Complete Assembly Nil 2 Pump Impeller/ Rotor with shaft 1 Set 3 Set of Bearings 1 Set 4 Set of Seals 1 Set k. DRAIN / MOISTURE TRAPS 1 set of each type / size. l. OIL COOLER GASKETS & SEALS 1 Set			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 34 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
3.00.00 3.01.00	m. AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM		
	1	Prefilter Element (Ceramic Candle or as applicable)	1 Set
	2	After Filter Element (Ceramic Candle) (Ceramic Candle or as applicable)	1 Set
	3	Heater Element (if applicable)	1 Set
	4	Blower Bearing (if applicable)	1 Set
	5	Blower Motor Bearing (if applicable)	1 Set
	6	Valves & Valve Actuators	1 No.
	7	Heater Coil for temperature Stabilisation (for HOC Type) (as applicable)	1 Set
	n. COMPRESSOR HOUSE CRANE		
	1	All bearings	Nil
	2	Brake assembly and its liners	1 set of each type/rating
	3	Wire rope	Nil
	MANDATORY SPARES:		
	PCP		
	S.No	Description	Quantity
1.	Spare gaskets for all the gate valve for sizes 15 mm NB to 500 mm NB	Nil	
2	Spare sets of gland packings of all the gate valves for all sizes	Nil	
3	Spare gaskets for all the globe valves for sizes 15 mm NB to 500 mm NB	Nil	
4	Spare sets of gland packings for all the Globe valves for all sizes	Nil	
5	Spare gaskets for NRV for all the valves	Nil	
6	Spare set of Gaskets for safety relief valves, for all sizes	Nil	
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC	
	7	Complete gate valves assly. Upto the size of 50 NB	Nil	
	8	Complete angle valves only upto the size of 50 NB	2 nos	
	9	Complete Globe valves up to the size of 50 NB	2 nos	
	10	Complete NRV's Assly. upto the size of 50 NB	2 nos	
	11	Complete needle valves upto the size of 50 NB	2 nos	
	12	Spring hangers (Variable spring & Constant spring hangers)	Nil	
	13	Gasket for each flanged connection on high pressure steam and feed line	Nil	
	14	Steam traps and Y- Strainers All internals required to complete one full assembly,except body	5% of total population of one (1) unit for each size, type, material and rating , or min.one (1) set	
	15	Other Valves (1) Each type, size and class for 100 mm and below but above 50 NB (2) Each type, size and Class above 100 mm	1 no. 10% or 2 nos. whichever is more	
	3.02.00	Note : Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied.		
LP PIPING				
Valves :5% of the total population of each type , size and class or minimum 1 no. of each type , size and class, whichever is higher.				
Note : Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied.				
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 36 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES 			
4.00.00	MANDATORY SPARES FOR LT SWITCHGEAR (AS APPLICABLE)			
	S.NO.	ITEM.	QUANTITY	
	1)	Complete pole of breaker		
	2)	Spring charging motors		
	3)	Aux. contact set		
	4)	Limit switches		
	5)	Arc chutes		
	6)	Fixed contact set		
	7)	Moving contact set		
	8)	Arcing contact		
	9)	Charging spring		
	10)	Current transformer (metering)		
	11)	Current transformer (protection)		
	12)	Closing coil		
	13)	Trip coil		
	14)	CT for Bimetal O/L relays		
	15)	Voltage transformer		
	16)	Control supply transformer		
	17)	Ammeter		
	18)	Voltmeter		
	19)	Relays		
	20)	Power contactor		
	21)	Coil of above contactor		
	22)	Air break switches		
	23)	DP air break switches (DC)		
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CLAUSE NO.	LIST OF MANDATORY SPARES 		
5.00.00	24)	Control & selector switches	
	25)	Control fuses & neutral links	
	26)	Indicating lamps	
	27)	Bus bar support insulators (each type)	
	28)	Bus duct flexibles connectors	
	29)	Primary disconnect in MCC (Male/ femal contact)	
	30)	Push buttons	
	31)	Power fuses	
	32)	Thermal bimetal relays	
	33)	Indication Lamp Holders complete	
	34)	Maintenance tools and accessories for Maintenance (bidder to list)	
	35)	Terminal blocks	
	36)	Busbar alluminium flat pieces	
	37)	Busbar angles/formed pieces for breaker	
	NOTE : a. Quantity mentioned in percentage (%) is the % of total installed.		
	b. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.		
	DISTRIBUTED DIGITAL CONTROL MONITORING AND INFORMATION SYSTEM (DDCMIS) (INCLUDING UNITS –SG C&I AND FUEL OILSYSTEM) 1. Peripherals (i) Keyboard 2 Nos. of each type. (ii) Mouse 2 Nos. of each type. (iii) Color laser printer (A4) One No.		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES PAGE 38 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES			
		(iv) Color laser printer (A3)	One No.	
		(v) Blank Compact discs	10 boxes	
		(vi) Long term storage unit	One No.	
	2.	HMIPIS Devices		
		(i) Work stations	One No. of each type and model.	
		(ii) Server for unit LAN or Information workstations (as applicable)	One No. of each type and model	
		(iii) Net work components like switch/repeaters/hubs etc.	2 Nos. of each type and model.	
		(iv) Other drives/peripheral devices of each type and model no. in MMIPIS like terminal Servers, DAT tape drive etc. (as applicable), which are not covered in above items but are required to make the system complete.	2 Nos. of each type and model	
		(v) Control unit for LVS	One No.	
	3.	Cables and Connectors.		
		(i) Prefab interconnecting cables with connectors	2 Nos. of each type and length, whichever is more.	
		(ii) System bus cable with connectors	2 Nos. of each type and length, whichever is more.	
		(ii) I/O bus cable with connectors for remote I/O units	2 Nos. of each type and length, whichever is more.	
	4	(i) Power Supply Modules & Power Packs for control system	10% of each type, model and rating	
		(ii) Intelligent UPS for workstation, server, PCs	One No. of each size and rating	
	5	Electronic modules of each type and model for control system (This shall include all type of cards like I/O cards, controller cards, CPU module or Card, logic cards etc.)		
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CLAUSE NO.	LIST OF MANDATORY SPARES			एनटीपीसी NTPC
	6	Bus coupler/Interface hardware/other Communication devices	10% of each type	
	7	Relays	10% of each type	
	8	PCs	One No. of each type & model.	
	9	Batteries used for battery backup of RAMs.	10 % of each type and model.	
	10	Fuses	200 %.	
	11	Expendable items including but not limited to the following Cooling fans for Power supply and cabinets	10% of each type and model.	
6.00.00	OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS/EQUIPMENTS			
6.01.00	Other SG related sub-systems			
	1	Flame Monitoring System		
	(i)	Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fibre optic cables.	20% or 4 Nos., whichever is more	
	(ii)	Flame Scanner Lens.	100%	
	(iii)	Electronic cards for scanners	10% or 2 Nos. of each type whichever is more.	
	(iv)	Power Supply Modules	10% or 2 Nos. of each type whichever is more.	
	2	Coal Feeders		
	(i)	Motion monitor	10% or 2 Nos. whichever is more.	
	(ii)	Speed pick-up	10% or 2 Nos. whichever is more.	
	(iii)	Torque switch	10% or 2 Nos. whichever is more.	
	(iv)	Load Cell	10% or 2 Nos. whichever is more.	
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
	(v)	Electronic cards & Power Supply cards	10% or 2 Nos. whichever is more.
	(vi)	Clutch (if applicable)	10% or 2 Nos. whichever is more.
	(vii)	Local indication lamps	200 %
	(viii)	Panel meters	10% or 2 Nos. whichever is more.
	(ix)	Limit switch assembly for coal-on-belt, no coal flow, shear pin failure, etc.	10% or 2 Nos., whichever is more.
	(x)	Coupling (eddy current type etc., if applicable)	10% or 2 Nos. whichever is more.
3	Electromatic Safety Valves		
		Pressure switches, local PB stations and solenoid Valves.	10% or 2 Nos. of each type whichever is more.
4	Furnace Temperature Probes		
		Thermocouple	2 Nos.
5	Acoustic Pyrometers		
	(i)	Signal Processor and interface modules	20% or 2 Nos. of each type and model whichever is more
	(ii)	Sensors and Transceivers	20% or 2 Nos. of each type and model which is more.
	(iii)	All Electronic Cards including Power Packs	20% or 2 Nos. of each type and model which is more.
6	Furnace and Flame Viewing System		
	(i)	Flame Cameras	10% or 2 Nos, whichever is more
	(ii)	Electronic Modules	10% or 2 Nos. of each type whichever is more
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CLAUSE NO.	LIST OF MANDATORY SPARES 		
7.00.00	7 Electronic remote drum level monitoring system (in case of drum type boilers)		
	(i) Electrodes	50% of population.	
	(ii) Electronic Cards	20% or 2 Nos. of each type and model whichever is more.	
	(iii) Lamps/LEDs of display units	100%	
	8 Mill and Air heater Fire detection system.		
	(i) Thermocouple	10%	
	(ii) Process actuator switches	10%	
	MEASURING INSTRUMENTS		
	1 Electronic Transmitters		
	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% of each type and model and model	
	2 Temperature elements		
	(i) RTD's* of each type and length	10% or 2 Nos. whichever is more	
	(ii) Thermocouples of each type like K-type, R-type, metal etc. and length *	10% or 2 Nos. whichever is more	
	(iii) Cold junction compensation boxes of each model	10% or 2 Nos. whichever is more	
	(iv) Thermostatic units for each model of CJC box.	10% or 2 Nos. whichever is more	
	(v) Thermowell for application like mill outlet temperature and SH/ RH/Eco/ true gas temp. in furnace	10% or 2 Nos. whichever is more	
	(vi) Temperature transmitters	10% of each type	
* (with head assembly, terminal block and nipple)			
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
	3	Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,	5% or One No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, model, type population)
	4	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	5% or 1 No. of each type and model whichever is more
	5	Electrical Metering Instruments Electrical meters including voltmeter, motor current ammeter,	5% or 1 No. of each model and type whichever is more.
	6.	PD Type Flow Transmitters	5% or 1 Set of each type and model whichever is more.
	7.	pH Analysers	5% or 1 Set of each type and model whichever is more.
	8.	Density Meters	5% or 1 Set of each type and model whichever is more.
	9.	Mass Flow Meters	5% or 1 Set of each type and model whichever is more.
	10	Flue Gas Sox Analyser	1 no. each complete Instrument
	(i)	Electronic Card Assemblies of each type	10%
	(ii)	Sets of Gaskets/"O" rings	2 sets.
	(iii)	Temperature Sensor & heater Assembly.	20%
	(iv)	Complete Probe with shield assembly.	2 nos.
	(v)	Air flow meter	1 no.
	(vi)	Consumables like filter elements light sources etc.	100 %
	(vii)	Calibration gases of all types and ranges.	One year supply.
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CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC	
8.00.00	POWER SUPPLY SYSTEM			
	1.	24 V DC power supply system	(To be Supplied for each 24 V DC Power Supply System)	
	(i)	Silicon controlled thyristers, diodes, power transistors	100%	
	(ii)	Capacitors	One Set	
	(iii)	Fuses of each types and rating	200%	
	(iv)	Fuse free Circuit breakers	5% or One No. of each type and rating, whichever is more	
	(v)	Electronic modules of all types.	10% or 2 Nos. of each type and model, whichever is more	
	(vi)	Indication Lamps	100%	
	(vii)	Lamp holders with series resistor, if any	10% or 2 Nos. of each type, whichever is more.	
	(viii)	Cooling Fans	10% or 2 Nos. of each type, whichever is more.	
9.00.00	PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE)			
	1	Valves of all types and models	10% or 1 No. of each type, class, size and model whichever is more.	
	2	2 way, 3way, 5way valve manifolds	10% or 1 No. of each type, class, size and model whichever is more.	
	3	Fittings	10% or 1 packet of each type, class, size and model whichever is more.	
	4	Purge meters	5% of each model or 2 Nos. whichever is less	
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CLAUSE NO.	LIST OF MANDATORY SPARES			
10.00.00	5	Filter regulators	20% of each model or 2 Nos. whichever is less	
	INSTRUMENTATION CABLE, INTERNAL WIRING			
	(i)	Pre fabricated cable of each type.	10% of installed quantity	
	(ii)	Pre fabricated cable connector of each type.	10% or 1 No. of each type and model, whichever is more.	
11.00.00	(iii)	Other cables	5 % of each type, pair and size of actual installed quantity	
	CONTROL VALVES, ACTUATORS & ACCESSORIES			
	1	Pneumatic and electro-hydraulic actuator assembly	10% or 1 No. of each type, model and rating, whichever is more	
	2	Position feed back transmitter	20% or 2 Nos. of each type, whichever is more.	
	3	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	One Set for each type of control valve, whichever is more.	
	4	Diaphragms, O' rings, seals etc. of all types, make etc.	200%	
	5	Pneumatic air-filter/Regulator of each type, make, rating etc.	10% or 2 Nos. whichever is more	
	6	Pressure Gauges of all types, make, rating etc.	10% or 2 Nos. of each type whichever is more.	
	7	Solenoid valves	10% or 2 Nos. of each type whichever is more.	
	8	Air lock relays	10% or 2 Nos. of each type whichever is more.	
	9	Pneumatic relays	10% or 2 Nos. of each type whichever is more.	
	10	Positioner unit	20% or 1 No. of each type whichever is more	
	12.00.00	MICROPROCESSOR BASED/PLC BASED CONTROL SYSTEM		
		1	Power Supply Unit	20 % or 2 Nos. of each type and model, whichever is more.
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CLAUSE NO.	LIST OF MANDATORY SPARES				एनटीपीसी NTPC
13.00.00	2	Electronic modules	10 % of each type and model,		
	3	i) Interconnecting Cables	One run length of each type and size		
		ii) Connectors	10%		
	4	Graphical Interface Unit	One No. of each size		
	5	Printer	One No.		
	6	Cooling Fan in PLC system/cabinet	10% or 2 Nos. which ever is more		
	7	Audible devices	10% or 2 Nos. of each type whichever is more.		
	PADO				
	1.	Work station with all accessories and licensed software	One No.		
	2.	Sensors	10% or 2 Nos. of each type whichever is higher		
15.00.00	3.	Interface cards	10% or 2 Nos. of each type whichever is higher		
	4.	Power Packs	10% or 2 Nos. of each type whichever is higher		
	5.	Prefab cables	10% or 2 Nos. of each type whichever is higher		
	MANDATORY SPARES FOR MILL REJECT HANDLING SYSTEM :				
	1.	Pneumatic conveying system			
		a.	Pneumatic main valves	:	8 set of each type
		b.	Pneumatic / solenoid twoee position control valve	:	8 sets of each type
		c.	Plate / dome valve (including seals) with actuators	:	16 Nos.
		d.	Plate / Dome valve seals	:	16 Sets
	2.	Compressures Reciprocating Compressors			
		HP Cylinder			
	1.	Small end bearing	:	2 sets	
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CLAUSE NO.	LIST OF MANDATORY SPARES				एनटीपीसी NTPC
	2 .	Big end bearing	:	2 sets	
	3 .	Piston ring (including all rings over piston)	:	4 sets	
	4 .	Oil wiper ring	:	2 sets	
	5 .	Suction valve	:	2 sets	
	6 .	Discharge valve	:	2 sets	
	7 .	Packing set	:	2 sets	
	LP Cylinders				
	1 .	Big end bearing	:	2 sets	
	2 .	Small end bearing	:	2 sets	
	3 .	Piston ring (including all rings over piston)	:	4 sets	
	4 .	Oil wiper ring	:	1 set	
	5 .	Suction valve	:	1 set	
	6 .	Discharge valve	:	1 set	
	7 .	Packing set	:	1 set	
	Cross Head				
	1 .	Throw away guide	:	1 no.	
	2 .	Crank shaft	:	1 no.	
	3 .	Main bearings	:	1 set	
	4 .	Piston LP	:	1 No.	
	5 .	Piston HP	:	1 No.	
	6 .	Connection rod	:	1 no. of each type	
	7 .	Packing ring	:	1 set	
	8 .	Sealing ring HP	:	1 set	
	9 .	Sealing ring LP	:	1 set	
	10.	Spring decompressor	:	1 set	
	11.	'O' ring piston	:	1 set	
	12.	Protection grill	:	1 set	
	13.	Ring copper	:	1 set	
	14.	Valve plate	:	1 set	
	15.	Cushion plate	:	1 set	
16.	Spring plate	:	1 set		
17.	Type coupling	:	Nil		
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CLAUSE NO.	LIST OF MANDATORY SPARES				एनटीपीसी NTPC																																																																														
	<table><tr><td></td><td colspan="4">Valves</td></tr><tr><td>1.</td><td>Check valve flap or disk</td><td>:</td><td>1 set</td></tr><tr><td>2.</td><td>Control valve disc with internal assembly</td><td>:</td><td>1 set</td></tr><tr><td>3.</td><td>Control valve gasket</td><td>:</td><td>Nil</td></tr><tr><td>4.</td><td>Control valve gland piping</td><td>:</td><td>Nil</td></tr><tr><td>5.</td><td>Gate, globe, shuttle check valve</td><td>:</td><td>1 no. of each type</td></tr><tr><td>6.</td><td>Gasket & seals of inter cooler</td><td>:</td><td>1 set</td></tr><tr><td>7.</td><td>Gasket and seals for after cooler</td><td>:</td><td>2 sets</td></tr><tr><td></td><td colspan="4">Oil Pump / Motor</td></tr><tr><td>1.</td><td>Oil pump complete assembly</td><td>:</td><td>1 set</td></tr><tr><td>2.</td><td>Pump impeller / rotor with shaft</td><td>:</td><td>1 set</td></tr><tr><td>3.</td><td>Set of bearing</td><td>:</td><td>1 set</td></tr><tr><td>4.</td><td>Set of seal</td><td>:</td><td>1 set</td></tr><tr><td></td><td colspan="4">SHAFT DRIVE OIL PUMP</td></tr><tr><td>1.</td><td>Drive gear with shaft</td><td>:</td><td>1 no.</td></tr><tr><td>2.</td><td>Driven gear with shaft</td><td>:</td><td>1 no.</td></tr><tr><td>3.</td><td>Driven pump element</td><td>:</td><td>1 set</td></tr><tr><td>4.</td><td>Oil cooler gasket & seals</td><td>:</td><td>1 set</td></tr><tr><td>5.</td><td>Moisture pump element</td><td>:</td><td>1 set</td></tr></table>					Valves				1.	Check valve flap or disk	:	1 set	2.	Control valve disc with internal assembly	:	1 set	3.	Control valve gasket	:	Nil	4.	Control valve gland piping	:	Nil	5.	Gate, globe, shuttle check valve	:	1 no. of each type	6.	Gasket & seals of inter cooler	:	1 set	7.	Gasket and seals for after cooler	:	2 sets		Oil Pump / Motor				1.	Oil pump complete assembly	:	1 set	2.	Pump impeller / rotor with shaft	:	1 set	3.	Set of bearing	:	1 set	4.	Set of seal	:	1 set		SHAFT DRIVE OIL PUMP				1.	Drive gear with shaft	:	1 no.	2.	Driven gear with shaft	:	1 no.	3.	Driven pump element	:	1 set	4.	Oil cooler gasket & seals	:	1 set	5.	Moisture pump element	:	1 set
		Valves																																																																																	
	1.	Check valve flap or disk	:	1 set																																																																															
	2.	Control valve disc with internal assembly	:	1 set																																																																															
	3.	Control valve gasket	:	Nil																																																																															
	4.	Control valve gland piping	:	Nil																																																																															
	5.	Gate, globe, shuttle check valve	:	1 no. of each type																																																																															
	6.	Gasket & seals of inter cooler	:	1 set																																																																															
	7.	Gasket and seals for after cooler	:	2 sets																																																																															
		Oil Pump / Motor																																																																																	
	1.	Oil pump complete assembly	:	1 set																																																																															
	2.	Pump impeller / rotor with shaft	:	1 set																																																																															
	3.	Set of bearing	:	1 set																																																																															
	4.	Set of seal	:	1 set																																																																															
		SHAFT DRIVE OIL PUMP																																																																																	
	1.	Drive gear with shaft	:	1 no.																																																																															
	2.	Driven gear with shaft	:	1 no.																																																																															
	3.	Driven pump element	:	1 set																																																																															
	4.	Oil cooler gasket & seals	:	1 set																																																																															
	5.	Moisture pump element	:	1 set																																																																															
	16.00.00	FUEL OIL HANDLING AND STORAGE SYSTEM																																																																																	
	16.01.00	Strainer elements																																																																																	
		a.	H.F.O. unloading pumps	2 nos.																																																																															
		b.	F.O. Drain pumps	1 no.																																																																															
		c.	L.F.O. unloading pumps	1 no.																																																																															
	16.02.00	Floor Coil Heater																																																																																	
	a.	H.F.O. storage tank	15% of total length of coil for one (1) no. H.F.O. storage tank																																																																																
	b.	Oil water separator pit	15% of total length of coil																																																																																

BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES	PAGE 48 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES		
16.03.00	Relief valve complete assembly		
	a. H.F.O. unloading pumps	1 no.	
	b. L.F.O. unloading pumps	1 no.	
	c. Pressure Reducing station	1 no.	
16.04.00	Bearings for		
	a. H.F.O. unloading pumps	1 set	
	b. L.F.O. unloading pumps	1 set	
	c. F.O. Drain pumps	1 set	
16.05.00	Rotor assembly (complete cartridge assembly)		
	a. H.F.O. unloading pumps	Nil	
	b. L.F.O. unloading pumps	Nil	
	c. F.O. Drain pumps	Nil	
16.06.00	Coupling Bolts with nuts, washer and bushes for HFO/LFO unloading pumps	1 set for each size of coupling	
16.07.00	Wearings Rings	1 set for each type of pump	
16.08.00	Gland Packing (if applicable)	1 set for each type of pump	
16.09.00	Mechanical seal Assembly (if applicable)	1 set each for HFO/LFO unloading cum transfer pump	
16.10.00	Shaft sleeve	1 set for each type of pump	
16.11.00	Valves (each type and size)	a) 1 number, where the total quantity of a particular type and size of valve is less than or equal to 10. b) 2 numbers, where the the total quantity of a particular type and size	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES PAGE 49 OF 50

CLAUSE NO.	LIST OF MANDATORY SPARES		एनटीपीसी NTPC
		of valve is less than 40 but more than 10. c) 5% of the total quantity (to nearest whole number) of a particular type and size of valve, where the total quantity of a particular type and size of valve is more than 40.	
16.12.00	Steam Trap	1 no. of each type and size	
16.13.00	Control valve (complete assy.)	One (1) no. complete for floor coil heaters.	
		One (1) no. complete for suction heaters.	
16.14.00	Pressure reducing valve	One (1) no.	
16.15.00	Neoprene rubber unloading hoses (for HFO) with end connections (complete hose)	Ten (10) nos.	
	Note : One (1) set means total number as required for one complete replacement of one equipment.		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII LIST OF MANDATORY SPARES
			PAGE 50 OF 50

CLAUSE NO.	QUALITY ASSURANCE													एन टी पी सी NTPC	
CONTROL VALVE ACTUATORS AND ACCESSORIES.															
ITEMS	TESTS	MAKE,MODEL,TAG (R)	DIMENSION®	SURFACE FINISH®	HEAT TREATMENT®	MATERIAL TEST CERTIFICATES®	IBR CERTIFICATES®	HYDRAULIC TEST®	UT/RADIOGRAPHY FOR >900 LB RATING®	MPI/DP®	PRESSURE RESISTANCE®	SEAT LEAKAGE®	TIMEING OPEN/CLOSE®	LINEARITY/HYSTERISIS®	FUNCTIONAL TEST, REVIEW FOR MAKE AND TC OF ACCESSORIES®
CONTROL VALVE AND ACTUATOR															
OVERALL		Y	Y	Y			Y	Y				Y	Y	Y	Y
BODY			Y	Y	Y	Y			Y	Y	Y				
BONNET			Y	Y	Y	Y									
TRIM			Y			Y			Y*						
PNEUMATIC ACTUATOR		Y	Y								Y				
R- ROUTINE TEST		A - ACCEPTANCE TEST				Y - TEST APPLICABLE									
Y* - UT ON SPINDLE DIA >= 40 MM. NOTE : 1) DETAILED PROCEDURE OF BURN-IN AND ELEVATED TEMPERATURE TEST SHALL BE AS PER QUALITY ASSURANCE PROGRAMME GENERAL TECHNICAL CONDITIONS 2) THIS IS AN INDICATIVE LIST OF TESTS/CHECKS. THE MANUFACTURE IS TO FURNISH A DETAILED QUALITY PLAN INDICATING HIS PRACTICE & PROCEDURE ALONG WITH RELEVANT SUPPORTING DOCUMENTS DURING QP FINALISATION FOR ALL ITEM.															
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE				TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2				SUB-SECTION-VII:QI-07 CONTROL VALVES ACTUATORS AND ACCESSORIES				PAGE 1 OF 1			

CLAUSE NO.	QUALITY ASSURANCE														
PROGRAMMABLE LOGIC CONTRLLER															
TESTS	ITEMS														
		Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade / Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ Mosaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element , Annunciation ®	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
	1. PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y			Y	Y
	2. Control Desk With PLC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents. *Applicable for PLC Y - Test Applicable , ® - Routine Test (A) - Acceptance Test															
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE				TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2				SUB-SECTION-VII:QI-09 PLC BASED CONTROL AND INST. PLANT AUX. SYSTEM				PAGE 1 OF 2			

CLAUSE NO.	QUALITY ASSURANCE						एनटीपीसी NTPC																
BATTERY CHARGER <table><tr><td> Attributes / Characteristics ↓ Items / Components / Sub- assembly </td><td>Make, Model, Type, Rating</td><td>Dimensional check and Paint shade, thickness, adhesion & Finish checks</td><td>Complete physical examination for constructional features as per approved drgs</td><td>Ripple Content Test, Load Limiter operation & AVR Operation Test</td><td>Operational & Functional Checks of aux. Devices like annunciator, switches, indicators etc.</td><td>HV & IR Test</td><td>Burn-In Test</td></tr><tr><td>Battery Charger</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr></table> Note 1 : This check list is applicable for Battery Charger of capacity upto 24 V / 48 V , 150 A DC. 2: Separate approval of QP is not envisaged. Main Contractor / nominated inspection agency will carry out the inspection as per above check-list and submit inspection report to NTPC for their review / acceptance of the same.								Attributes / Characteristics ↓ Items / Components / Sub- assembly	Make, Model, Type, Rating	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per approved drgs	Ripple Content Test, Load Limiter operation & AVR Operation Test	Operational & Functional Checks of aux. Devices like annunciator, switches, indicators etc.	HV & IR Test	Burn-In Test	Battery Charger	Y	Y	Y	Y	Y	Y	Y
Attributes / Characteristics ↓ Items / Components / Sub- assembly	Make, Model, Type, Rating	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per approved drgs	Ripple Content Test, Load Limiter operation & AVR Operation Test	Operational & Functional Checks of aux. Devices like annunciator, switches, indicators etc.	HV & IR Test	Burn-In Test																
Battery Charger	Y	Y	Y	Y	Y	Y	Y																
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-VII:QI-09 PLC BASED CONTROL AND INST. PLANT AUX. SYSTEM		PAGE 2 OF 2																	

CLAUSE NO.	QUALITY ASSURANCE 			
	FLUE GAS DESULPHURISATION SYSTEM 1.00.00 FLUE GAS DESULPHURISATION SYSTEM 1.01.00 Mills : 1.01.01 Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness. 1.01.02 Wear-resistant parts shall be UT/ RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out. 1.01.03 Butt welds in the tube/ separator /body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced. 1.01.04 All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed. 1.02.00 Feeders : 1.02.01 Any welds in the casing/ pulley fabrication shall be checked with MPI. 1.02.02 Routine tests shall be done as per relevant Indian Standards or equivalent International Standards. 1.02.03 All major items like plates for casings, head pulley, tail pulley, Pulley shaft and major castings shall be procured with respective material test certificates. 1.02.04 Calibration check shall be carried out on all feeders. 1.03.00 Dampers : 1.03.01 All the dampers shall be subjected to operational test/checks. 1.03.02 Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness for minimum one damper of each type and size offered. 1.04.00 PIPING, VALVE AND SPECIALITIES : 1.04.01 All pipes and fittings shall be tested as per applicable code. 1.04.02 All valves shall be hydraulically/ Air tested for body, seat and back-seat (if applicable) as per relevant standard.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-VII:QM-10 FLUE GAS DESULPHURISATION SYSTEM PAGE 1 OF 3

CLAUSE NO.	QUALITY ASSURANCE 			
1.04.03	NDT on valves shall be as per relevant standard.			
1.04.04	Valves shall be offered for hydro test in unpainted condition.			
1.04.05	Functional checks of the valves for smooth opening and closing shall also be done.			
1.05.00	TANKS / VESSELS :			
1.05.01	Atmospheric Tank:			
	(i) All weld joints shall be DP tested and complete tanks shall be water fill tested. (ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code as applicable.			
1.05.02	Pressure Vessel:			
	(1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below: (i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds. (ii) 10% DPT on all finished butt welds (iii) 10% RT (covering all 'T'/cross joints) of butt welds (2) Butt Welds of dished ends shall be stress relieved and subjected to 100% RT. (3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.			
1.06.00	HEAT EXCHANGER / HEATER			
1.06.01	All material shall be tested for chemical and mechanical properties as per relevant standard.			
1.06.02	NDT on welds and other checks shall be as per relevant code.			
1.07.00	PUMPS:			
1.07.01	UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defect.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VII:QM-10 FLUE GAS DESULPHURISATION SYSTEM	PAGE 2 OF 3

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
1.07.02	The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.			
1.07.03	The pump rotating parts shall be subjected to static and dynamic balancing.			
1.07.04	All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant / applicable standard.			
1.07.05	Noise and vibration shall be measured during the performance testing at shop.			
1.08.00	Structure, Ducts, Hoppers:			
1.08.01	All material shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.			
1.08.02	Visual inspection of all welds shall be performed in accordance with AWS D.1.1.			
1.08.03	NDT requirements of structural steel welds shall be as under:- (i) 100% RT/UT on butt-welds of plate thickness ≥ 32 mm. (ii) For plates of $25\text{mm} \leq \text{thickness} < 32\text{mm}$ - 10% RT and 100% MPI (iii) For plates of thickness $< 25\text{mm}$ - 10% MPI/LPI.			
1.08.04	Edge for shop and field weld shall be examined by MPI for plate thickness $\geq 32\text{mm}$.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-VII:QM-10 FLUE GAS DESULPHURISATION SYSTEM
PAGE 3 OF 3				

CLAUSE NO.	SALIENT DESIGN DATA			
1.00.00	COAL The primary fuel for the main Steam Generator(s) shall be a blended coal from supplies from Makum Coal Fields of NECL and Non Ranigang Coal fields of ECL viz Mugma, Salanpur, SP mines and Rajmahal Coal Fields. The quality parameters of the above coals and also of the blended coal are given in Table-1 (A, B & C).			
2.00.00	FUEL OIL			
2.01.00	The fuel oils to be used for start-up, coal flame stabilisation and low load operation of the steam generator shall be HPS/LSHS/Heavy Furnace Oil having the characteristics given at Table-3 and Table-4 gives Light Oil characteristics for Light Oil firing system.			
2.02.00	The design and construction of the steam generator shall be suitable for firing all the oils mentioned above for operation of the steam generator and the heavy oil pressurization, heating, tracing and atomization systems shall be designed to handle all these oils.			
3.00.00	FEED WATER			
3.01.00	Feed water for the steam generator under normal operating conditions shall be condensate from surface condenser of a 250 MW turbine generator unit. This feed water, before entering into the economiser will be heated in a train of heaters, deaerator and high pressure heaters. Probable make-up quantity may be of the order of 1.5% and will be provided at the condenser. Make up of the cycle shall be demineralized water having silica content not exceeding 0.02 ppm and conductivity not exceeding 0.2 micro mhos/cm. The dissolved oxygen content in feed water leaving the dearator shall be maintained to a level of not more than 0.005 ml/lit. It is proposed to have hydrazine dosing in the feed water suction line to boiler feed pumps.			
3.02.00	The feed water quality at the economiser inlet shall be as given below :			
	Conductivity	:	0.1 micromhos/cm	
	Hydrazine	:	0.01-0.02 ppm	
	pH value	:	9.2 – 9.5	
	Oxygen	:	Not detectable	
	Iron	:	Less than 0.005 ppm (Max)	
	Copper	:	Less than 0.002 ppm (Max)	
	SiO2	:	Less than 0.002 ppm (Max)	
	CO2	:	Nil	
	Oil	:	Nil	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-V SALIENT DESIGN DATA
				PAGE 1 OF 13

CLAUSE NO.	SALIENT DESIGN DATA	एनटीपीसी NTPC		
4.00.00	Sodium : 0.002 ppm (Max) Permanganate : Nil Chlorides : 0.002 ppm (Max) Hardness : Nil AMBIENT AIR For the purpose of design and sizing of Steam Generators and its auxiliaries, the ambient air temperature and relative humidity shall be taken as 27 degree Celsius and 60% respectively, unless specifically mentioned otherwise. The Steam Generator and its auxiliaries shall, however, also be so sized that they are capable of giving maximum continuous rating within the range of ambient air temperature from 5 degree Celsius to 42 degree Celsius for the specified range of coals.			
5.00.00	PARAMETERS FOR DESIGN / SIZING / GUARANTEES / OPERATING CAPABILITIES Tentative parameters to be used for design, sizing, guarantees and operating capabilities of Steam Generator(s) and other equipments/systems/auxiliaries etc. in Steam Generator Package are given at Table-2(A) and Table 2(B) of this Sub-Section. These parameters are tentative and are for tender purpose only. Final parameters shall be intimated to the successful Bidder after finalisation of Turbine Generators. Table-2(A) gives Steam and feed water parameters under "Boiler Maximum Continuous Rating" (BMCR) conditions. Table-2(B) gives Steam and feed water parameters under constant pressure operation of the units at 100% "Turbine Maximum Continuous Rating (TMCR), 80% TMCR, 60% TMCR and 50% TMCR. The conditions are the most likely operating conditions of the units and therefore all quoted guarantees etc. shall be with reference to parameters indicating in this Table. Further reference to Table-2(B) shall be made for parameters, wherever such term "TMCR" is referred in the Technical Specifications. Though the parameters indicated are for constant pressure, the steam generator shall be capable of operating under sliding pressure also and design data pertaining to this shall be furnished by the supplier during detail engineering for employer's approval.			
6.00.0	LIMESTONE The limestone shall be sources from Umrangshu mines of Assam Mineral Development Corporation. The limestone characteristics are given in Table 5.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-V SALIENT DESIGN DATA
		PAGE 2 OF 13		

CLAUSE NO.	SALIENT DESIGN DATA																																																																																																																																																																								
	(SHEET 1 OF 6) TABLE – 1 COAL CHARACTERISTICS (A) NECL (ASSAM) COAL <table> <tr> <th rowspan="2">Sl. No.</th><th rowspan="2">Description</th><th rowspan="2">Symbol</th><th rowspan="2">Design Coal</th><th rowspan="2">Worst Coal</th><th rowspan="2">Best Coal</th><th colspan="2">Range of Adequacy Coal</th></tr> <tr> <th>Worst</th><th>Best</th></tr> <tr> <th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th></tr> <tr> <td colspan="8">A. PROXIMATE ANALYSIS (As received basis)</td></tr> <tr> <td>1.</td><td>Total Moisture</td><td>%</td><td>12</td><td>15</td><td>10</td><td>16</td><td>8</td></tr> <tr> <td>2.</td><td>Ash</td><td>%</td><td>18</td><td>22</td><td>13</td><td>23</td><td>10</td></tr> <tr> <td>3.</td><td>Volatile matter</td><td>%</td><td>30</td><td>27</td><td>32</td><td>26</td><td>34</td></tr> <tr> <td>4.</td><td>Fixed carbon</td><td>%</td><td>40</td><td>36</td><td>45</td><td>35</td><td>48</td></tr> <tr> <td>5.</td><td>Total</td><td>%</td><td>100</td><td>100</td><td>100</td><td>100</td><td>100</td></tr> <tr> <td colspan="8">B. ULTIMATE ANALYSIS (As received basis)</td></tr> <tr> <td>1.</td><td>Carbon</td><td>%</td><td>48.7</td><td>43.8</td><td>53.1</td><td>42.7</td><td>57.2</td></tr> <tr> <td>2.</td><td>Hydrogen</td><td>%</td><td>4.5</td><td>4</td><td>5</td><td>3.9</td><td>5.5</td></tr> <tr> <td>3.</td><td>Sulphur</td><td>%</td><td>3.1</td><td>2.8</td><td>3.4</td><td>2.7</td><td>3.5</td></tr> <tr> <td>4.</td><td>Nitrogen</td><td>%</td><td>2</td><td>1.8</td><td>2.2</td><td>1.7</td><td>2.3</td></tr> <tr> <td>5.</td><td>Oxygen (By difference)</td><td>%</td><td>11.7</td><td>10.6</td><td>12.9</td><td>10</td><td>13.1</td></tr> <tr> <td>6.</td><td>Carbonates</td><td>%</td><td>0</td><td>0</td><td>0.4</td><td>0</td><td>0.4</td></tr> <tr> <td>7.</td><td>Phosphorous</td><td>%</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>8.</td><td>Total Moisture</td><td>%</td><td>12</td><td>15</td><td>10</td><td>16</td><td>8</td></tr> <tr> <td>9.</td><td>Ash</td><td>%</td><td>18</td><td>22</td><td>13</td><td>23</td><td>10</td></tr> <tr> <td>10.</td><td>Total</td><td>%</td><td>100</td><td>100</td><td>100</td><td>100</td><td>100</td></tr> <tr> <td>11.</td><td>Gross Calorific Value</td><td>KCal/Kg</td><td>5000</td><td>4500</td><td>5500</td><td>4400</td><td>6000</td></tr> </table>							Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal		Worst	Best	1	2	3	4	5	6	7	8	A. PROXIMATE ANALYSIS (As received basis)								1.	Total Moisture	%	12	15	10	16	8	2.	Ash	%	18	22	13	23	10	3.	Volatile matter	%	30	27	32	26	34	4.	Fixed carbon	%	40	36	45	35	48	5.	Total	%	100	100	100	100	100	B. ULTIMATE ANALYSIS (As received basis)								1.	Carbon	%	48.7	43.8	53.1	42.7	57.2	2.	Hydrogen	%	4.5	4	5	3.9	5.5	3.	Sulphur	%	3.1	2.8	3.4	2.7	3.5	4.	Nitrogen	%	2	1.8	2.2	1.7	2.3	5.	Oxygen (By difference)	%	11.7	10.6	12.9	10	13.1	6.	Carbonates	%	0	0	0.4	0	0.4	7.	Phosphorous	%	0	0	0	0	0	8.	Total Moisture	%	12	15	10	16	8	9.	Ash	%	18	22	13	23	10	10.	Total	%	100	100	100	100	100	11.	Gross Calorific Value	KCal/Kg	5000	4500	5500	4400	6000
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal																																																																																																																																																																			
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4.	Fixed carbon	%	40	36	45	35	48																																																																																																																																																																		
5.	Total	%	100	100	100	100	100																																																																																																																																																																		
B. ULTIMATE ANALYSIS (As received basis)																																																																																																																																																																									
1.	Carbon	%	48.7	43.8	53.1	42.7	57.2																																																																																																																																																																		
2.	Hydrogen	%	4.5	4	5	3.9	5.5																																																																																																																																																																		
3.	Sulphur	%	3.1	2.8	3.4	2.7	3.5																																																																																																																																																																		
4.	Nitrogen	%	2	1.8	2.2	1.7	2.3																																																																																																																																																																		
5.	Oxygen (By difference)	%	11.7	10.6	12.9	10	13.1																																																																																																																																																																		
6.	Carbonates	%	0	0	0.4	0	0.4																																																																																																																																																																		
7.	Phosphorous	%	0	0	0	0	0																																																																																																																																																																		
8.	Total Moisture	%	12	15	10	16	8																																																																																																																																																																		
9.	Ash	%	18	22	13	23	10																																																																																																																																																																		
10.	Total	%	100	100	100	100	100																																																																																																																																																																		
11.	Gross Calorific Value	KCal/Kg	5000	4500	5500	4400	6000																																																																																																																																																																		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2			SUB-SECTION-V SALIENT DESIGN DATA																																																																																																																																																																			
						PAGE 3 OF 13																																																																																																																																																																			

CLAUSE NO.	SALIENT DESIGN DATA						
	एनटीपीसी NTPC						
	(SHEET 2 OF 6)						
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal	
						Worst	Best
1	2	3	4	5	6	7	8
12.	Hard grove index		55	50	60	45	65
13.	YGP	(mg/kg)	75	80	70	85	65
C. ASH ANALYSIS							
1.	Silica	%	40.4	37.5	42.3	37.4	42.4
2.	Alumina	%	9.79	8.8	10.9	8.7	11.1
3.	Iron Oxide	%	27.15	35.66	22.9	36.6	22
4.	Titania	%	0.96	0.6	1.1	0.5	1.2
5.	Phosphoric Anhydride	%	0.35	0.25	0.4	0.2	0.45
6.	Lime	%	2.55	2.15	2.7	2.1	2.8
7.	Magnesia	%	0.63	0.54	0.8	0.5	0.9
8.	Sulphuric Anhydride	%	14.67	11.7	15.1	11.3	15.2
9.	Sodium oxide	%	0.2	0.1	0.3	0.1	0.35
10.	Potassium oxide	%	3.3	2.7	3.5	2.6	3.6
	Total		100	100	100	100	100
NOTE: Na ₂ O content in the above shall not be more than 0.1%.							
D. ASH FUSION RANGE (Under reducing atmosphere)							
a)	Initial Deformation Temperature (IDT) °C		1075	1050	1100	1050	1100
b)	Hemispherical temperature °C		1125	1100	1150	1100	1150
c)	Fusion temperature °C		1175	1150	1200	1150	1200
Note : For information purposes to bidder as this coal / ash data is constituent of range of coals (blended).							
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2			SUB-SECTION-V SALIENT DESIGN DATA	
						PAGE 4 OF 13	

CLAUSE NO.	SALIENT DESIGN DATA						
	(SHEET 3 OF 6) TABLE – 1 COAL CHARACTERISTICS (B) ECL COAL						
	Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
							Worst Best
	1	2	3	4	5	6	7 8
	A.						
	PROXIMATE ANALYSIS (As received basis)						
	1.	Total Moisture	%	15	19	13	19 13
	2.	Ash	%	40	45	35	46 34
	3.	Volatile matter	%	18	15	20	15 20
	4.	Fixed carbon	%	27	21	32	20 33
	5.	Total	%	100	100	100	100 100
	B.						
	ULTIMATE ANALYSIS (As received basis)						
	1.	Carbon	%	32.06	25.54	38.12	24.71 39.06-
	2.	Hydrogen	%	3.4	3.15	3.59	3.1 3.65
	3.	Sulphur	%	0.4	0.6	0.36	0.6 0.3
	4.	Nitrogen	%	0.75	0.33	0.9	0.3 0.95
	5.	Oxygen (By difference)	%	7.71	5.68	8.44	5.58 8.5
	6.	Carbonates	%	0.65	0.67	0.55	0.68 0.5
	7.	Phosphorous	%	0.03	0.03	0.04	0.03 0.04
	8.	Total Moisture	%	15	19	13	19 13
	9.	Ash	%	40	45	35	46 34
	10.	Total	%	100	100	100	100 100
	11.	Gross Calorific Value	KCal/Kg	3400	2900	3900	2800 4000
	12.	Hard grove index		51	43	61	42 62
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2			SUB-SECTION-V SALIENT DESIGN DATA	
						PAGE 5 OF 13	

CLAUSE NO.	SALIENT DESIGN DATA						
	(SHEET 4 OF 6)						
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal	
						Worst	Best
1	2	3	4	5	6	7	8
13	YGP	mg/kg	90	95	85	100	80
C.	ASH ANALYSIS						
1.	Silica	%	65.83	63.5	66.3	63	66.6
2.	Alumina	%	21.78	20.8	22.4	20.5	22.7
3.	Iron Oxide	%	6.79	10.66	4.8	11.7	3.8
4.	Titania	%	1.76	1.65	1.86	1.6	1.9
5.	Phosphoric Anhydride	%	0.13	0.1	0.2	0.1	0.25
6.	Lime	%	1.33	1.15	1.45	1.1	1.5
7.	Magnesia	%	0.34	0.24	0.45	0.2	0.5
8.	Sulphuric Anhydride	%	0.75	0.7	0.8	0.6	0.9
9.	Sodium Oxide	%	0.1	0.1	0.2	0.1	0.25
10.	Potassium Oxide	%	1.19	1.1	1.5	1.1	1.6
	Total		100	100	100	100	100
D.	ASH FUSION RANGE (Under reducing atmosphere)						
a)	Initial Deformation Temperature (IDT) °C		1150	1100	1200	1100	1200
b)	Hemispherical temperature °C		1300	1250	1350	1250	1350
C)	FUSION TEMPERATURE °C		1400	1400	1400	1400	1400
Note : For information purposes to bidder as this coal / ash data is constituent of range of coals (blended).							
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-V SALIENT DESIGN DATA		PAGE 6 OF 13

CLAUSE NO.	SALIENT DESIGN DATA						
	एनटीपीसी NTPC (SHEET 5 OF 6) TABLE – 1 COAL CHARACTERISTICS (C) BLENDED COAL						
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal	
						Worst	Best
1	2	3	4	5	6	7	8
A. PROXIMATE ANALYSIS (As received basis)							
1.	Total Moisture	%	13.26	16.68	11.26	17.26	10.1
2.	Ash	%	27.24	31.66	22.24	32.66	20.08
3.	Volatile matter	%	24.96	21.96	26.96	21.38	28.12
4.	Fixed carbon	%	34.54	29.7	39.54	28.7	41.7
5.	Total	%	100	100	100	100	100
B. ULTIMATE ANALYSIS (As received basis)							
1.	Carbon	%	41.71	36.13	46.81	35.14	49.58
2.	Hydrogen	%	4.04	3.64	4.41	3.56	4.72
3.	Sulphur	%	1.97	1.88	2.12	1.82	2.16
4.	Nitrogen	%	1.48	1.18	1.65	1.11	1.73
5.	Oxygen (By difference)	%	10.02	8.53	11.03	8.14	11.17
6.	Carbonates	%	0.27	0.28	0.46	0.29	0.44
7.	Phosphorous	%	0.01	0.01	0.02	0.01	0.02
8.	Total Moisture	%	13.26	16.68	11.26	17.26	10.10
9.	Ash	%	27.24	31.66	22.24	32.66	20.08
10.	Total	%	100	100	100	100	100
11.	Gross Calorific Value	KCal/Kg	4328	3828	4828	3728	5160
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-V SALIENT DESIGN DATA		PAGE 7 OF 13

CLAUSE NO.	SALIENT DESIGN DATA						एन टी पी सी NTPC	
(SHEET 6 OF 6)	Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal	
							Worst	Best
	1	2	3	4	5	6	7	8
	12.	Hard grove index		51	43	61	42	62
	13	YGP	mg/kg	90	95	85	100	80
	C. ASH ANALYSIS							
	1.	Silica	%	51.08	48.42	52.38	48.15	52.56
	2.	Alumina	%	14.83	13.84	15.73	13.66	15.97
	3.	Iron Oxide	%	18.60	25.16	15.31	26.14	14.36
	4.	Titania	%	1.30	1.04	1.42	0.96	1.49
	5.	Phosphoric Anhydride	%	0.26	0.19	0.32	0.16	0.37
	6.	Lime	%	2.04	1.73	2.18	1.68	2.25
	7.	Magnesia	%	0.51	0.41	0.65	0.37	0.73
	8.	Sulphuric Anhydride	%	8.82	7.08	9.09	6.81	9.91
	9.	Sodium Oxide	%	0.16	0.10	0.26	0.10	0.31
	10.	Potassium Oxide	%	2.41	2.03	2.66	1.97	2.76
		Total		100	100	100	100	100
D. ASH FUSION RANGE (Under reducing atmosphere)								
a)	Initial Deformation Temperature (IDT) °C		1075	1050	1100	1050	1100	
b)	Hemispherical temperature °C		1125	1100	1150	1100	1150	
c)	Fusion temperature °C		1175	1150	1200	1150	1200	
Note : For design, sizing and guarantee purposes.								
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-V SALIENT DESIGN DATA		PAGE 8 OF 13	

CLAUSE NO.	SALIENT DESIGN DATA		एनटीपीसी NTPC																														
	TABLE-2 (A) PARAMETERS UNDER BMCR CONDITION <table><tr><th>Sl.No.</th><th>Description</th><th>100% BMCR</th></tr><tr><td>1.</td><td>Steam flow at superheater Outlet (T/hr)</td><td>810</td></tr><tr><td>2.</td><td>Pressure at Superheater outlet kg/cm² (abs)</td><td>155</td></tr><tr><td>3.</td><td>Temperature at Superheater outlet (Deg C)</td><td>540</td></tr><tr><td>4.</td><td>Steam flow to reheater (T/hr)</td><td>696.7</td></tr><tr><td>5.</td><td>Steam Pressure at HP Turbine Exhaust Kg/cm² (abs)</td><td>41.99</td></tr><tr><td>6.</td><td>Steam temperature at HP Turbine Exhaust Deg C</td><td>346.9</td></tr><tr><td>7.</td><td>Steam Temperature at Reheater Outlet Deg C</td><td>540</td></tr><tr><td>8.</td><td>Pressure drop through the reheater including cold and hot Rehaeater piping kg/cm²</td><td>4 Kg/cm²</td></tr><tr><td>9</td><td>Feed Water Temperature at Economiser inlet (°C)</td><td>249.3</td></tr></table> NOTE: The parameters are tentative and for tender purpose only. Final parameters shall be intimated to the successful Bidder after finalization of Turbine Generators hence provision of minor variation in parameters shall kept in Steam Generator design.			Sl.No.	Description	100% BMCR	1.	Steam flow at superheater Outlet (T/hr)	810	2.	Pressure at Superheater outlet kg/cm ² (abs)	155	3.	Temperature at Superheater outlet (Deg C)	540	4.	Steam flow to reheater (T/hr)	696.7	5.	Steam Pressure at HP Turbine Exhaust Kg/cm ² (abs)	41.99	6.	Steam temperature at HP Turbine Exhaust Deg C	346.9	7.	Steam Temperature at Reheater Outlet Deg C	540	8.	Pressure drop through the reheater including cold and hot Rehaeater piping kg/cm ²	4 Kg/cm ²	9	Feed Water Temperature at Economiser inlet (°C)	249.3
Sl.No.	Description	100% BMCR																															
1.	Steam flow at superheater Outlet (T/hr)	810																															
2.	Pressure at Superheater outlet kg/cm ² (abs)	155																															
3.	Temperature at Superheater outlet (Deg C)	540																															
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6.	Steam temperature at HP Turbine Exhaust Deg C	346.9																															
7.	Steam Temperature at Reheater Outlet Deg C	540																															
8.	Pressure drop through the reheater including cold and hot Rehaeater piping kg/cm ²	4 Kg/cm ²																															
9	Feed Water Temperature at Economiser inlet (°C)	249.3																															
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-V SALIENT DESIGN DATA PAGE 9 OF 13																														

CLAUSE NO.	SALIENT DESIGN DATA							
	TABLE-2 (B) SALIENT DATA FOR DESIGN AND SIZING OF BOILER FOR CONSTANT PRESSURE OPERATION							
	Sl.No	Description	100% BMCR	250 MW Constant Pressure	200 MW Constant Pressure	150 MW Constant Pressure	125 MW Constant Pressure	All HP Heaters Out Constant Pressure
	1	Steam flow at superheater Outlet (T/hr)	810	738.6	590.2	446.7	376.2	706.8
	2.	Pressure at Superheater outlet kg/cm2 (abs)	155	154.2	152.7	151.5	151.1	153.8
	3.	Temperature at Superheater outlet (deg.C)	540.0	540.0	540.0	540.0	540.0	540.0
	4.	Steam flow to reheater (T/hr)	696.7	666.65	537.7	411.0	348.1	700.24
	5.	Steam Pressure at HP Turbine Exhaust Kg/cm2 (abs)	41.99	39.58	31.61	24	20.27	41.95
	6.	Steam temperature at HP turbine exhaust (deg.C)	346.9	344.8	338	331.4	328.1	357
	7.	Steam Temperature at Reheater Outlet (Deg.C)	540.0	540.0	540.0	540.0	540.0	540.0
	8.	Pressure drop through the reheater including cold and hot reheat piping kg/cm2 (abs)	4 kg/cm2 max at BMCR and correspondingly lower for the other operating conditions					
	9.	Feed Water Temperature at Economizer inlet (Deg.C)	249.3	246	234.2	219.7	210.9	167.9
Note : (I) The parameters are tentative and for tender purpose only. Final parameters shall be intimated to the successful Bidder after finalization of Turbine Generators. (ii) TMCR means "Turbine Maximum Continuous Rating"								
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2			SUB-SECTION-V SALIENT DESIGN DATA		PAGE 10 OF 13

CLAUSE NO.	SALIENT DESIGN DATA				एनटीपीसी NTPC
	TABLE - 3 FUEL OIL CHARACTERISTICS				
Sl. No.	Characteristics Oil IS-1953	Heavy Furnace Heavy Stock 1971 Grade HV	Low Sulphur Petroleum (LSHS)	Heavy Stock (HPS)	
1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.	
2.	Gross calorific value (KCal/kg)	of the order of 11,000	of the order of 11,000	9,500 (min)	
3.	Flash Point (Min)	66 deg C	75 deg C	75 deg C	
4.	Water content by volume (Max)	1.0%	1.0%	1.0%	
5.	Sediment by weight (Max)	0.25%	0.25%	0.25%	
6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%	
7.	Kinematic viscosity in Centistokes at - 50deg C (Max)	370	180	500	
8.	Ash Content by weight (Max.)	0.1%	0.05%	0.1%	
9.	Acidity (inorganic)	Nil	Nil	Nil	
10.	Pour Point (Max.)	57 deg C	72 deg C		
11.	Sodium content	—	—	100 ppm	
12.	Vanadium content	25 ppm	25 ppm	25 ppm	
13.	Specific heat below pour point (KCal/Kg °C)		0.65		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-V SALIENT DESIGN DATA	PAGE 11 OF 13

TABLE - 4

LIGHT DIESEL OIL CHARACTERISTICS

AS PER IS 1460-1974 WITH AMMENDMENTS UPTO OCT. 85

Characteristics		LDO
1.	Pour Point (max)	12 deg.C & 18°C for Summer and Winter respectively
2.	Kinematic viscosity in centistokes at 38 deg.C	2.5 to 15.7
3.	Waste content, percent by volume (max)	0.25
4.	Sediment percent by mass (max)	0.10
5.	Total sulphur percent by mass (max)	1.8
6.	Ash percentage by mass (max)	0.02
7.	Carbon residue (Rans bottom) percent by pass (max.)	1.50
8.	Acidity in organic	Nil
9.	Flash point (Min.) – Pensky Martens Abel	66 deg.C. -
10.	Acidity, total, mg of KOH/g (max.)	-
11.	Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2
12.	Total sediment mg per 100 ml max. = 1.0	Not worse than No.2

CLAUSE NO.	SALIENT DESIGN DATA			एनटीपीसी NTPC
	TABLE - 5 LIMESTONE CHARACTERSTICS			
	Chemical Analysis		%	
	1.	CaO	48-51	
	2.	MgO	1-1.4	
	3.	Fe ₂ O ₃	1.5-2.2	
	4.	Al ₂ O ₃	1.8-2.8	
	5.	Si ₂ O ₃	4-6	
	6.	Mn ₂ O ₃ , P ₂ O ₅ , Cl ₂ , Na ₂ O, K ₂ O, TiO ₂	Below 0.2	
	7.	Total Sulphur	Trace	
	8.	LOI	38-41	
	9.	Total Carbonate	85-89	
	Impurity Level			
	1	Acid + Alkali insoluble	Below 1%	
	Hardness & Size			
	1	Bond Index	3	
	2	Granule size	Medium	
	3	Colour	Grey	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 13 OF 13

SUB SECTION - III

DETAILED TECHNICAL SPECIFICATION (ELECTRICAL SYSTEMS)

Consists of :

SUB-SECTION	DESCRIPTION
III E-01	Motors
III E-02	LT Switchgear
III E-03	LT Power Cables
III E-04	LT Control Cables
III E-05	Cabling, Earthing & Lightning Protection
III E-06	Elevators Electricals
III E-07	Variable Frequency Drive
III E-08	ESP Electrical Portion
III E-09	Electrical Actuators

SUB SECTION - III E-01

MOTORS

SUB SECTION - III E-02

LT SWITCHGEAR

SUB SECTION - III E-03

LT POWER CABLES

SUB SECTION - III E-04

LT CONTROL CABLES

SUB SECTION - III E-05

CABLING, EARTHING & LIGHTING PROTECTION

SUB SECTION - III E-06

ELEVATORS

SUB SECTION - III E-07

VARIABLE FREQUENCY DRIVE

SUB SECTION - III E-08

ESP ELECTRICAL PORTION

SUB SECTION - III E-09

ELECTRICAL ACTUATORS

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	MOTORS 1.00.00 GENERAL REQUIREMENTS 1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment. 1.02.00 All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. 1.03.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services. 1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations. 1.05.00 The auxiliary AC voltage supply arrangement shall have 6.6 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition : (a) 6.6 kV +/- 6% (b) 415/240V +/- 10% 1.06.00 The voltage level for motors shall be as follows :- a) Upto 0.2KW : Single phase 240V AC / 3 phase 415V AC b) Above 0.2KW and upto 200KW : 3 phase 415V AC c) Above 200KW : 6.6 kV 1.07.00 Fault level shall be limited to 40kA RMS for 1 second for 6.6kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC system shall be isolated type.	
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2	SUB-SECTION-III-E-01 MOTORS PAGE 1 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS																
1.08.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.																
1.09.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.																
1.10.00	Degree of Protection Degree of protection for various enclosures as per IS:13947 shall be as follows :- <table border="0"> <tr> <td>i) Indoor motors</td><td>-</td><td>IP 54</td></tr> <tr> <td>ii) Outdoor motors</td><td>-</td><td>IP 55</td></tr> <tr> <td>iii) CW motors (in case of screen prot. Drip proof)</td><td>-</td><td>IP 23</td></tr> <tr> <td>iv) Cable box - indoor area</td><td>-</td><td>IP 54</td></tr> <tr> <td>v) Cable box - outdoor area</td><td>-</td><td>IP 55</td></tr> </table>	i) Indoor motors	-	IP 54	ii) Outdoor motors	-	IP 55	iii) CW motors (in case of screen prot. Drip proof)	-	IP 23	iv) Cable box - indoor area	-	IP 54	v) Cable box - outdoor area	-	IP 55	
i) Indoor motors	-	IP 54															
ii) Outdoor motors	-	IP 55															
iii) CW motors (in case of screen prot. Drip proof)	-	IP 23															
iv) Cable box - indoor area	-	IP 54															
v) Cable box - outdoor area	-	IP 55															
2.00.00	CODES AND STANDARDS <table border="0"> <tr> <td>1) Three phase induction motors</td><td>:</td><td>IS:325, IEC:60034</td></tr> <tr> <td>2) Single phase AC motors</td><td>:</td><td>IS:996, IEC:60034</td></tr> <tr> <td>3) Crane duty motors</td><td>:</td><td>IS:3177, IEC:60034</td></tr> <tr> <td>4) DC motors/generators</td><td>:</td><td>IS:4722</td></tr> </table>	1) Three phase induction motors	:	IS:325, IEC:60034	2) Single phase AC motors	:	IS:996, IEC:60034	3) Crane duty motors	:	IS:3177, IEC:60034	4) DC motors/generators	:	IS:4722				
1) Three phase induction motors	:	IS:325, IEC:60034															
2) Single phase AC motors	:	IS:996, IEC:60034															
3) Crane duty motors	:	IS:3177, IEC:60034															
4) DC motors/generators	:	IS:4722															
3.00.00	TYPE																
3.01.00	AC Motors: (a) Squirrel cage induction motor suitable for direct-on-line starting. (b) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.																
3.02.00	DC Motors Shunt wound.																
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2 SUB-SECTION-III-E-01 MOTORS PAGE 2 OF 9															

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.00.00	RATING (a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.	
5.00.00	TEMPERATURE RISE Air cooled motors 70 deg. C by resistance method for both class B&F insulation. Water cooled 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both class B&F insulation.	
6.00.00	OPERATIONAL REQUIREMENTS	
6.01.00	Starting Time	
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.	
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.	
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.	
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
6.02.00	Torque Requirements	
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.	
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.	
6.03.00	Starting voltage requirement (a) 85% upto 1500KW (d) 80% from 1501 KW to 4000KW (e) 75% > 4000KW	
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES	
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.	
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below (a) Fuel oil area : Group - IIB (b) Hydrogen generation : Group - IIC (or Group-I, Div-II as per NEC) plant area	
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature (c) 6.6 kV : Class F : with winding temperature rise limited to	
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2 SUB-SECTION-III-E-01 MOTORS PAGE 4 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	AC motors Class B. They shall withstand 1.2/50 microsec. switching surges of $4U+5$ KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 20KV followed by 1 min power frequency high voltage test of appropriate voltage. on inter turn insulation. (d) 415V AC & 220V : Class B or better DC motors 7.04.00 Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents. 7.05.00 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature. 7.06.00 Noise level for all the motors shall be limited to 85dB(A). Vibration shall be limited within the limits prescribed in IS:12075 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads. 7.07.00 In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and two numbers duplex platinum resistance type temperature detectors. 7.08.00 Motor body shall have two earthing points on opposite sides. 7.09.00 HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. In case cable box is offered, then Employer shall provide termination kit. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes. 7.10.00 The spacing between gland plate & centre of terminal stud shall be as per Table-I. 7.11.00 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.	
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2	SUB-SECTION-III-E-01 MOTORS PAGE 5 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	
7.12.00	The motors shall be suitable for bus transfer schemes provided on the 6.6 kV/ 415V systems without any injurious effect on its life.	
7.13.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.	
7.14.00	6.6KV motor Terminal Box shall be suitable for fault level of 500MVA for 0.12 sec. Terminal boxes of breaker operated LT motors above 160KW shall be capable of withstanding system fault level of 31MVA for 0.12 second.	
7.15.00	The size and number of cables (for HT and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.	
7.16.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) (a) Upto 110KW: 11.0 (b) Above 110KW & upto 1500KW: 10.0 (c) Above 1500KW & upto 4000KW: 9.0 (d) Above 4000KW: 6 to 6.5	
8.00.00	TYPE TEST	
8.01.00	HT MOTORS	
8.01.01	The contractor shall carry out the type tests as indicated in the "LIST OF TYPE TESTS TO BE CONDUCTED " on the equipment mentioned there in. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Owner's Engineer.	
8.01.02	The type tests shall be carried out in presence of the Owner's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Owner's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
8.01.03	In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit the reports of the type tests indicated in the "LIST OF TYPE TESTS TO BE CONDUCTED " to the owner for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Owner reserves the right to waive conducting of any or all of the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.	
8.01.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.	
8.01.05	LIST OF TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary overload test (subject to test bed constraint). (d) Full load test (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
8.01.06	(f) Surge withstand test on the sample coil after placing it in stator core at $(4U + 5 \text{ KV})$ and with at least five impulse of 1.2/50 micro sec. Wave, where U is the line to line voltage in kV. (g) Surge-withstand test at 20KVp with 0.3/3 micro sec. wave on each type of 6.6 KV motor coils respectively with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out the turns suitably. The power frequency test voltage shall be decided during detailed engineering.	
	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor	
	(a) Degree of protection test for the enclosure followed by IR, HV and no load run test. (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Type test report on Elastimold terminal connector as per ANSI/IEEE-386-1985	
	8.02.00 LT Motors	
	8.02.01 LT motors shall be of type tested quality. For each type & rating of LT motors rated above 50 KW, the contractor shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.	
8.02.02	In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.	
8.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																													
	TABLE - I DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS <table><tr><th>Motor MCR in KW</th><th>Minimum distance between centre of stud and gland plate in mm</th></tr><tr><td>UP to 3 KW</td><td>As per manufacturer's practice.</td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>203</td></tr></table> For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:. <table><tr><th>Motor MCR in KW</th><th>Clearance</th></tr><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></table>				Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm	UP to 3 KW	As per manufacturer's practice.	Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	203	Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	LT SWITCHGEAR			
1.00.00	CODES AND STANDARDS			
	IEC : 60947, IS : 13947			
2.00.00	TYPE			
	Circuit Breakers	Shall be air break, three pole, spring charged, horizontal drawout type, suitable for electrical operation.		
	Switchgear	Fully drawout type single front		
	MCC	Fully drawout type single front/Double front.		
	ACDB/DCDB	Fixed type single front		
3.00.00	SYSTEM PARAMETERS			
	415VAC +/- 10% (SOLIDLY GROUNDED)			
	50 Hz +3%/-5%			
	50KA RMS (105kA peak) / 1 SEC (FAULT LEVEL)			
	220V DC NOMINAL (190V DC-240V DC) ISOLATED TYPE			
4.00.00	TEMPERATURE RISE			
	The temperature rise of the horizontal and vertical busbars and main bus link including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg. C with silver plated joints and 40 deg. C with all other types of joints over an ambient of 50 deg C.			
5.00.00	OPERATIONAL REQUIREMENTS			
5.01.00	Breakers			
5.01.01	Breakers shall have anti-pumping feature.			
5.01.02	The incomer and bus coupler breakers for switchgear shall be electrically operated with over current releases or relays.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.01.03	Breakers shall have inherent fault making and breaking capacities.They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers Shall have built in interlocks for equipment and personnel safety.			
5.01.04	Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changerover is provided.Breaker contact multiplication, if required, shall be through latch relay.			
5.01.05	Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.			
5.01.06	Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.			
5.01.07	Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.			
5.01.08	Supervision relay shall be provided for trip coil monitoring.			
5.02.00	Switches, Contactors and Fuses			
5.02.01	Incomers for MCCs and DBs rated upto 630A could be load break isolators.			
5.02.02	Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilisation category.			
5.02.03	Fuses shall be HRC type with operation indicator. Isolating switches shall be of AC 23A category when used in motor circuit, and AC 22A category for other applications. Fuse switch combination shall be provided wherever possible.			
5.02.04	Isolating switches and MCCBs shall have door interlocks and padlocking facility.			
5.03.00	Panels			
5.03.01	All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.			
5.03.02	Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall have DOP of IP-55. Push buttons shall be of latch type with mushroom knobs.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.03.03	Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.			
5.03.04	All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanized steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.			
5.03.05	Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.			
5.03.06	The incoming connection to transformer of more than 1000KVA and inter-connecting sections between switchboards shall preferably be of busducts. The busduct enclosure shall be made of minimum 3mm thick aluminium alloy. The section of the busduct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminium sheet hood shall be provided for outdoor busduct enclosure joints to provide additional protection against water ingress. The busduct top shall be sloped to prevent retention of water. The busduct shall have DOP of IP55.			
5.03.07	It should be possible to carry out maintenance on a feeder with adjacent feeders alive.			
5.04.00	Control, Protection & Metering Requirements			
5.04.01	Control circuits shall operate at suitable voltage of 110V AC or 220V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per section. However the breakers shall operate on 220V DC. The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.			
5.04.02	Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and down stream breakers/fuses/MCCBs motor starters. Various equipments shall meet requirement of Type-II class of coordination as per IEC.			
5.04.03	All relays and timers shall operate on available DC supply and not have any inbuilt batteries. They shall be provided with hand-reset operation indicator (flags) or LEDs with pushbuttons for resetting.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.04.04	All equipments shall have necessary protections. However, following minimum protections shall be provided: 1) Contactor controlled motor feeders (Motors up to 160 kW) a) Instantaneous short circuit protection on all phases through HRC cartridge type fuses rated for 80 kA rms (prospective breaking capacity at 415V). b) Thermal overload protection. c) Single phasing protection for motors protected by fuses. 2) Breaker controlled motors feeders (motors rated above 160kW) a) Instantaneous short circuit protection on all phases b) Overload protection on two phases c) Over load alarm on third phase d) Earth fault protection e) Under voltage protection f) hand reset lockout relay with a blue lamp for monitoring 3) Incomers/bus coupler/outgoing breaker feeders other than motor feeders. a) Definite time delay short circuit protection b) Hand reset lockout relay with a blue lamp 4) Incomer From DG Set. a) Differential Protection (87) - Three Pole b) Reverse Power Protection. c) Overload Alarm on one phase d) Earth Fault Detection Relay (64) e) Voltage controlled overcurrent relay			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	f) Generator under/over voltage Protection g) Hand Reset/Lockout Relay with a blue lamp. h) 3 Phase Energy Meter having accuracy of 1.0 class.			
5.04.05	Meters / instruments All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 2.0.			
5.04.06	All motors of 30kW and above shall have an Ammeter. All the heater feeders shall be provided with Ammeters. Bus-section shall have voltmeter with selector switch, and other relay and timers as required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.			
5.04.07	In case of remote controlled breaker panels, following shall be ensured. Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/remote selector switch is in local position. Tripping from remote shall be possible either when breaker is in service position or selector switch being in remote position.			
5.05.00	Control from Remote Necessary hardware shall be provided in the switchgear panel like coupling relays(24V DC, with max burden 2.5VA), auxiliary relays, current & voltage transducers(4-20 mA, dual output) etc. to effect interlocks, exchange information/ status and exercise control from remote.			
6.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
6.01.00	All 415V switch gear motor control centers (MCCs), AC & DC distribution boards (DB s), etc shall have following features : 1) Shall be of metal enclosed, indoor, floor mounted and free standing type. 2) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	3) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels. 4) All switchboards/panels shall be of dust and vermin proof. All cutouts shall have synthetic rubber gaskets. 5) For motors above 160kW, remote controlled electrical circuit breakers, and for smaller motors, switch-fuse contactor feeders shall be provided. The other outgoing feeders would be switch-fuse units or moulded case circuit breakers. 6) All switchboards, MCCs and DB s shall have following distinct vertical sections. a) Completely enclosed bus bar compartment for horizontal and vertical bus bars. b) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder). c) Compartment for cable alley or cable box for power and control cables. In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables. d) For cable connection to circuit breaker, a separately enclosed cable compartment shall also be acceptable. e) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary. f) The switchboards/MCC/DBs of 1600A & above rating shall be of DOP IP42 & of IP52 for less than 1600A rating. g) All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade complete panels excluding end covers shall be RAL 9002 & RAL 5012 for extreme end covers of all panels.			
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2	SUB-SECTION-III-E-02 LT SWITCHGEAR	PAGE 6 OF 9	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	h) All 415V switchgears,MCC's, AC & DC distribution boards etc. shall have two incomers and one buscoupler arrangement ,unless asked for specifically. i) All drawout modules shall have distinct service, test and isolated positions.Power contacts shall get disconnected in both test and isolated positions where as the control contacts shall get disconnected in isolated position only. 7) Busbars shall be of high conductivity aluminium alloy or copper. 8) The cross-section of the horizontal busbars shall be uniform throughout the length of switchboard and both horizontal as well as vertical busbars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars. 9) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit. 10) Busbar insulators shall be of track-resistant high strength non-hygroscopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted. 11) All types of relays and timer shall be subject to Employer's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacemernt and testing facility. The auxiliary relays and timer may be provided in fixed cases. 12) Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS/PLC. 13) The switchgears/MCC shall be designed to offer adequate level of safety to operating/maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means			
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2	SUB-SECTION-III-E-02 LT SWITCHGEAR	PAGE 7 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC												
	provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room discribing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC. 14) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. The accuracy shall be as follows: <table><thead><tr><th></th><th>CTs</th><th>PTs</th></tr></thead><tbody><tr><td>Protection</td><td>5P20</td><td>3P</td></tr><tr><td>Metering</td><td>1.0</td><td>1.0</td></tr><tr><td>REF</td><td>PS</td><td></td></tr></tbody></table>					CTs	PTs	Protection	5P20	3P	Metering	1.0	1.0	REF	PS	
	CTs	PTs														
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Metering	1.0	1.0														
REF	PS															
6.02.00	Indicating lamps shall be cluster LED type.															
6.03.00	20% spare feeders of each type & rating used in the MCC with a minimum one (1) number on each bus section shall be provided.															
7.00.00	TYPE TESTS															
7.01.00	GENERAL															
	(a) All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. (b) In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.															
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2	SUB-SECTION-III-E-02 LT SWITCHGEAR	PAGE 8 OF 9												

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																								
	LT POWER CABLES																											
1.00.00	CODES & STANDARDS																											
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes: <table><tr><td>IS :1554 - I</td><td>PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</td></tr><tr><td>IS : 3961</td><td>Recommended current ratings for cables</td></tr><tr><td>IS : 3975</td><td>Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.</td></tr><tr><td>IS : 4905</td><td>Methods for random sampling.</td></tr><tr><td>IS : 5831</td><td>PVC insulation and sheath of electrical cables.</td></tr><tr><td>IS:7098(Part-I)</td><td>Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.</td></tr><tr><td>IS : 8130</td><td>Conductors for insulated electrical cables and flexible cords.</td></tr><tr><td>IS : 10418</td><td>Specification for drums for electric cables.</td></tr><tr><td>IS : 10810</td><td>Methods of tests for cables.</td></tr><tr><td>ASTM-D-2843</td><td>Standard test method for density of smoke from the burning or decomposition of plastics.</td></tr><tr><td>IEC-754(Part-I)</td><td>Test on gases evolved during combustion of electric cables.</td></tr><tr><td>IEC -332</td><td>Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)</td></tr></table>				IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.	IS : 3961	Recommended current ratings for cables	IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.	IS : 4905	Methods for random sampling.	IS : 5831	PVC insulation and sheath of electrical cables.	IS:7098(Part-I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.	IS : 8130	Conductors for insulated electrical cables and flexible cords.	IS : 10418	Specification for drums for electric cables.	IS : 10810	Methods of tests for cables.	ASTM-D-2843	Standard test method for density of smoke from the burning or decomposition of plastics.	IEC-754(Part-I)	Test on gases evolved during combustion of electric cables.	IEC -332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
2.00.00	TECHNICAL REQUIREMENTS			
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.			
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.			
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.			
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg.C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg.C.			
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.			
2.06.00	For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables armouring shall be of galvanised steel as follows : -			
	Calculated nominal dia of cable under armour	Size and Type of armour		
	i) Upto 13 mm	1.4mm dia GS wire		
	ii) Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire		
	iii) Above 25 & upto 40 mm	0.8 mm thick GS formed wire / 2.0 mm dia GS wire		
	iv) Above 40 & upto 55mm	1.4 mm thick GS formed wire / 2.5 mm dia GS wire		
	v) Above 55 & upto 70 mm	1.4 mm thick GS formed wire / 3.15 mm dia GS wire		
	vi) Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire		
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2		SUB-SECTION-III-E-03 LT POWER CABLES
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC														
2.06.01	The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of .028264 ohms mm ² per meter at 20 deg C. Aluminium armouring shall be same as indicated above for galvanized steel.															
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface, of GS wire/formed wire.															
2.07.00	Outer sheath shall be of PVC(of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a) Oxygen index of min. 29 (As per IS:10810(Part-58)) (b) Acid gas emission of max. 20% (As per IEC-754-I). (c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D2843.															
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: <table><tr><td>1 core</td><td>-</td><td>Red, Black, Yellow or Blue</td></tr><tr><td>2 core</td><td>-</td><td>Red & Black</td></tr><tr><td>3 core</td><td>-</td><td>Red, Yellow & Blue</td></tr><tr><td>4 core</td><td>-</td><td>Red, Yellow, Blue and Black</td></tr></table>	1 core	-	Red, Black, Yellow or Blue	2 core	-	Red & Black	3 core	-	Red, Yellow & Blue	4 core	-	Red, Yellow, Blue and Black			
1 core	-	Red, Black, Yellow or Blue														
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3 core	-	Red, Yellow & Blue														
4 core	-	Red, Yellow, Blue and Black														
2.09.00	For reduced neutral conductors the core shall be black.															
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a) Cable size and voltage grade - To be embossed (b) Word 'FRLS' at every 5 metre - To be embossed (c) Sequential marking of length of the cable in metres at every one metre- To be embossed / printed. The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.															
BONGAIGAON THERMAL POWER PROJECT (3 X 250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO. : CS-4610-101-2	SUB-SECTION-IIIIE-03 LT POWER CABLES	PAGE 3 OF 7												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part -3.			
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.			
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.			
2.14.00	Cable selection & sizing			
2.14.01	Cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time. (d) The minimum conductor size shall be 6 sq.mm for Al conductor cables & 2.5 sq.mm for copper conductor cables. The constructional details of copper conductor cables shall be same as indicated for copper control cables.			
2.14.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.			
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.14.04	Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.			
2.14.05	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.			
3.00.00	CONSTRUCTIONAL FEATURES			
3.01.00	1.1 KV Grade Power Cables (a) 1.1KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). (b) 1.1KV grade PVC power cables shall have aluminium conductor(compact type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I). (c) 1.1KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250 deg.C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968			
3.02.00	Cable Drums (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS : 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
4.00.00	TESTS			
4.01.00	GENERAL			
	(a) All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. (b) In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract, free of cost to the Owner and submit the reports for approval. (c) All acceptance and routine tests as specified below and in relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
4.02.00	Type Tests :			
4.02.01	The reports for the following type tests shall be submitted on one size each of PVC/XLPE LT Power cables :			
	S.No.	Type Tests	Remarks	
	a)	For Conductor		
		1. Resistance test		
	b)	For Armour Wires/ Formed Wires		
		2. Measurement of Dimensions		
		3. Tensile Test		
		4. Elongation test		
		5. Torsion test	For round wires only	
		6. Winding test	For Formed wires only	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	7. Resistance test 8. a) Zinc Coating test For G.S. Formed wires /wires only. b) Wrapping test For aluminium wires/formed wires only. c) For PVC/XLPE insulation & PVC Sheath 9. Test for thickness 10. Tensile strength & elongation tests before ageing and after ageing 11. Ageing in air oven 12. Loss of mass test For PVC insulation and sheath only 13. Hot deformation test For PVC insulation and sheath only 14. Heat shock test For PVC insulation and sheath only 15. Shrinkage test 16. Thermal stability test For PVC insulation and sheath only 17. Hot set test For XLPE insulation only 18. Water absorption test For XLPE insulation only 19. Oxygen index test For outer sheath only 20. Smoke density test For outer sheath only 21. Acid gas generation test For outer sheath only d) For completed cables 22. Insulation resistance test (Volume resistivity method) 23. High voltage test 24. Flammability test as per IEC - 332 Part-3 (Category -B)		
4.03.00	Acceptance Tests: As per QA table		
4.04.00	Routine Tests : As per QA table		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																						
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2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.			
2.03.00	Conductor of control cables shall be made of multi stranded, plain annealed copper.			
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.			
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.			
2.06.00	For multicore armoured cables, the armouring shall be of galvanised steel as follows:-			
		Calculated nominal dia of cable under armour	Size and Type of armour	
	1)	Upto 13 mm	1.4mm dia GS wire	
	2)	Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	
	3)	Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	
	4)	Above 40 upto 55mm	1.4 mm thick GS formed wire/ 2.5mm dia GS wire	
	5)	Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	
	6)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire	
	The gap between armour wire / formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.			
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2.07.00	Outer sheath shall be of PVC(grade as applicable) and grey in colour . In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a) Oxygen index of min. 29 (As per IS:10810(Part-58)) (b) Acid gas emission of max. 20% (As per IEC-754-I). (c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D2843.			
2.08.00	Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted. 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black 5 core - Red, Yellow, Blue, Black and Grey			
2.09.00	For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed under neath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutire numbers shall not exceed 50 mm.			
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath : (a) Cable size and voltage grade - To be embossed (b) Word 'FRLS' at every 5 metre - To be embossed (c) Sequential marking of length of the cable in metres at every one metre. - To be embossed / printed.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.			
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part -3.			
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.			
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.			
2.14.00	Cable selection & sizing (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time. (d) The minimum size of conductor shall be 1.5 sq.mm.			
2.14.01	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.			
2.14.02	Cable lengths shall be considered in such a way that straight through cable joints are avoided.			
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2.14.03	Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.			
3.00.00	CONSTRUCTIONAL FEATURES			
3.01.00	1.1 KV Grade Control Cables			
	Control Cables shall have stranded copper conductor multicore PVC insulated, PVC inner-sheathed ,armoured / unarmoured, PVC outer-sheathed conforming to IS:1554. (Part-I).			
3.02.00	Cable Drums (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS : 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.			
4.00.00	TESTS			
4.01.00	GENERAL (a) All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. (b) In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specifica-			
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	tion requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval. (c) All acceptance and routine tests as specified below and in relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
4.02.00	Type Tests:			
4.02.01	The Type tests reports for the following shall be submitted for one size each of LT control cable :			
	S. No.	Type Test	Remarks	
	a)	For Conductor		
	1.	Resistance test		
	b)	For Armour Wires / Formed Wires		
	2.	Measurement of Dimensions		
	3.	Tensile Test		
	4.	Elongation test		
	5.	Torsion test	For round wire only	
	6.	Winding test	For Formed wires only	
	7.	Resistance test		
	8.	Zinc Coating test	For G.S. conductors only.	
	c)	For PVC insulation & PVC Sheath		
	9.	Test for thickness		
	10.	Tensile strength and elongation test before ageing and after ageing		
	11.	Ageing in air oven		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	12. Loss of mass test For PVC insulation and sheath only 13. Hot deformation test For PVC insulation and sheath only 14. Heat shock test For PVC insulation and sheath only 15. Shrinkage test 16. Thermal stability test For PVC insulation and sheath only 17. Oxygen index test For outer sheath only 18. Smoke density test For outer sheath only 19. Acid gas generation test For outer sheath only	
	d) For completed cables 20. Insulation resistance test (Volume resistivity method) 21. High voltage test 22. Flammability test as per IEC - 332 Part-3 (Category-B)	
4.03.00	Acceptance Tests: As per QA Table	
4.04.00	Routine Tests :As per QA Table	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	CABLING, EARTHING & LIGHTNING PROTECTION			
1.00.00	CODES AND STANDARDS			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable . IS:513 Cold rolled low carbon steel sheets and strips. IS:802 Code of practice for the use of Structural Steel in Overhead Transmission Line Towers. IS:1079 Hot Rolled carbon steel sheet & strips IS:1239 Mild steel tubes, tubulars and other wrought steel fittings IS:1255 Code of practice for installation and maintenance of power cables upto and including 33 KV rating IS:1367 Part-13 Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners). IS:2147 Degree of protection provided by enclosures for low voltage switchgear and control gear IS:2309 Code of Practice for the protection of building and allied structures against lightning. IS:2629 Recommended practice for hot dip galvanising of iron & steel IS:2633 Method for testing uniformity of coating on zinc coated articles. IS:3043 Code of practice for Earthing IS:3063 Fasteners single coil rectangular section spring washers. IS:6745 Methods for determination of mass of zinc coating on zinc coated iron & steel articles.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.02.00	IS:8308 Compression type tubular in- line connectors for aluminium conductors of insulated cables IS:8309 Compression type tubular terminal ends for aluminium conductors of insulated cables. IS:9537 Conduits for electrical installation. IS:9595 Metal - arc welding of carbon and carbon manganese steels - recommendations. IS:13573 Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests. BS:476 Fire tests on building materials and structures IEEE:80 IEEE guide for safety in AC substation grounding IEEE:142 Grounding of Industrial & commercial power systems DIN 46267 (Part-II) Non tension proof compression joints for Aluminium conductors. DIN 46329 Cable lugs for compression connections, ring type ,for Aluminium conductors VDE 0278 Tests on cable terminations and straight through joints BS:6121 Specification for mechanical Cable glands for elastomers and plastic insulated cables. Indian Electricity Act. Indian Electricity Rules. Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.00.00	EQUIPMENT DESCRIPTION	
2.01.00	Cable trays, Fittings & Accessories	
2.01.01	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.	
2.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.	
2.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm and of tray cover shall be minimum 1.6 mm.	
2.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanised as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm	
2.02.00	SUPPORT SYSTEM FOR CABLE TRAYS	
2.02.01	Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".	
2.02.02	Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.03.03	Duct banks Shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.			
2.04.00	Junction Boxes			
2.04.01	Junction Boxes with IP:55 degree of protection, shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation			
2.04.02	Terminal blocks shall be 650 volts grade, rated for 10 Amps and in one piece moulding. It shall be complete with insulating barriers, Klip-on-type terminals and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be Elmex type CSLT-1 with insulating material of Melamine conforming to ESI Standard 12.1 or equivalent. Terminal block shall be suitable for terminating 2 wires of 2.5 sq mm. on both sides arranged to facilitate easy termination			
2.05.00	Terminations & Straight Through Joints			
2.05.01	Termination and jointing kits for 11 kV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11 kV grade joints and terminations shall be type tested as per IS:13573. 3.3 kV grade joints and terminations shall be type tested as per VDE 0278. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solderless crimping type cable lugs & ferrule as per DIN standard.			
2.05.02	Straight through joint and termination shall be capable of withstanding the fault level for 11 kV system and for 3.3 kV system.			
2.05.03	1.1 KV grade STJ shall be of proven design.			
2.06.00	Cable glands			
2.06.01	Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS:6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to			
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2.07.00 2.07.01 2.08.00 2.08.01 2.09.00 2.09.01 2.10.00 2.10.01 2.10.02 2.11.00 2.11.01	insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene and of tested quality. Cable lugs/ferrules Cable lugs for power cables shall be Aluminium solderless crimping type conforming to IS:8309 suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper conforming to IS:8309. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Trefoil clamps Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak. Cable Clamps & Straps The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment Galvanising Galvanising of steel components and accessories shall conform to IS:2629 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified Welding The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.00.00	INSTALLATION			
3.01.00	Cable tray and Support System Installation			
3.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. All cable trays shall be in vertical configuration in boiler & ESP areas.			
3.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the enclosed drawings.			
3.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant tray layout drawings			
3.01.04	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.			
3.01.05	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining Project Manager's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.			
3.02.00	Conduits/Pipes/Ducts Installation			
3.02.01	The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.			
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3.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.												
3.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of coundits/pipes shall be sealed with Glasswool/Cement Mortar/Putty to prevent entrance of moisture and foreign material												
3.02.04	Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise												
	<table><tr><th>Conduit/pipe size (dia).</th><th>Spacing</th></tr><tr><td>Upto 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm</td><td>3.0 M</td></tr></table>	Conduit/pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm	3.0 M		
Conduit/pipe size (dia).	Spacing												
Upto 40 mm	1 M												
50 mm	2.0 M												
65-85 mm	2.5 M												
100 mm	3.0 M												
3.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.												
3.03.00	Junction Boxes Installation												
3.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings or as decided by Project Manager and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.												
3.04.00	Cable Installation												
3.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same di-												
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3.04.02	rection as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture. While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.			
3.04.03	Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager			
3.04.04	Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top-most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.			
3.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.			
3.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ PVC pipe.			
3.04.07	Joints for less than 250 Meters run of cable shall not be permitted.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.04.08	In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing			
3.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.			
3.04.10	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.			
3.04.11	Seperation At least 300mm clearance shall be provided between : - HT power & LT power cables, - LT power & LT control/instrumentation cables,			
3.04.12	Segregation 1) Segregation means physical isolation to prevent fire jumping. 2) All cables associated with the unit shall be segregated from cables of other units. 3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set. 4) In switchyard, control cables of each bay shall be laid on separate racks/trays.			
3.04.13	Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	No. of cores in cable	No. of spare cores		
	2C, 3C	NIL		
	5C	1		
	7C-10C	2		
3.04.14	Directly Buried Cables			
	a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.			
	b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.			
3.04.15	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags			
3.04.16	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.05.00	Cable Terminations & Connections			
3.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.			
3.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.			
3.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.			
3.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.			
3.05.05	The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number as per the drawings. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.			
3.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.			
3.05.07	It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.			
4.00.00	EARTHING SYSTEM			
4.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts.			
4.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
4.03.00	The material of the earthing conductors shall be as follows :			
	1)	Conductors above ground level and in built up trenches.	-	Galvanized steel
	2)	Conductors buried in earth	-	Mild steel
	3)	Earth electrodes	-	Mild steel rod
4.04.00	The sizes of earthing conductors for various electrical equipments shall be as below:			
	Equipment	Earth conductor buried in earth		Earth conductor above ground level & in built-up trenches
	a)	Main earth grid	40 mm dia. MS rod	65x8mm GS flat
	b)	33KV/11KV swltchgear/ 415V equipment	---	65x8mm GS flat
	c)	3.3 kV switchgear/ 415V MCC/Distri- bution boards/ Transformers	---	50x6mm GS fla
	d)	LT Motors above 125 KW	---	50 x 6mm GS flat
		25 KW to 125 KW	---	25 x 6mm GS flat
		1KW to 25 KW	---	25 x 3mm GS flat
		Fractional House power motor	---	8 SWG GS wire
	e)	Control panel & control desk	---	25 x 3 mm GS flat
	f)	Push button station/ Junction Box	---	8 SWG GI wire
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	g)	Columns, structures, cable trays and busducts enclosures	---	50x6mm GS flat
	h)	Crane, rails, rail tracks & other non-current carrying metal parts	---	25x6mm GS flat
4.05.00	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise instructed by the Employer. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.			
4.06.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 metre. Wherever earth mat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground.			
4.07.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.			
4.08.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.			
4.09.00	Suitable earth risers as approved by Project Manager shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.			
4.10.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.11.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.	
4.12.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.	
4.13.00	Earth pit shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal if average resistance of soil is more than 20 ohm metre.	
4.14.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.	
5.00.00	LIGHTNING PROTECTION SYSTEM	
5.01.01	Lightning protection system shall be in strict accordance with IS:2309	
5.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system	
5.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings	
5.02.00	Down Conductors - Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode. - Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. - All joints in the down conductors shall be welded type. - Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval. - Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system. 7. Lightning conductors shall not pass through or run inside GI Conduits. 8. Testing link shall be made of galvanized steel of size 25x 6mm.			
6.00.00	QUALITY ASSURANCE PROGRAMME			
6.01.00	Bidder shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/ International Standards and the requirements of this specification including tests listed in this section.			
7.00.00	TESTS			
7.01.01	All equipment to be supplied shall be of type tested quality. The contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.			
7.01.02	In case the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract free of cost to the owner and submit the reports for approval.			
7.01.03	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
7.02.00	Type Test reports shall be furnished for the following			
7.02.01	Type tests on Cable Trays support system a) Test 1A: On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as			
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	shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals: i) Working load ii) Working load + point load iii) Off load iv) Proof load + point load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied. B) Test 1B : Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2 Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; defelection shall be measured at points shown in the enclosed drawings at the following load intervals.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	i) Working load ii) Working load + Point load iii) Off load iv) Proof load + Point load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied b) Test 2 B : The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side. Test 3 : Tests on Channel Fixed on Beam/Floor A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place. b) Test 3B : With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place. c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.03.01	Galvanizing Tests The quality of galvanizing shall be inspected visually and shall be smooth, continuous, free from flux stains In addition following tests shall be conducted : i) Uniformity of coating - The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal. ii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplated areas, blisters and modules. iii) In addition, the plating thickness shall be determined microscopically/chemically or electronically.			
7.03.02	Welding The quality of welding shall be visually inspected, particular attention being paid to the following points. 1) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes. 2). The weld metal shall be properly fused with the parent metal without undercutting. 3) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.			
7.03.03	Physical and dimensional checks for all items.			
7.03.04	All conduits/pipes,etc. shall be routine/acceptance tested as per relevant standards.			
7.03.05	All acceptance and routine tests on cable glands as for BS:6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.			
7.03.06	Deflection test cable trays.			
7.03.07	All acceptance and routine tests on Junction boxes.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.03.08	Following tests shall also be carried out on each type of equipments, devices and materials/items supplied: 1) Physical and Dimensional checks 2) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs. 3) Check chemical composition of brass parts for cable glands. 4) Hardness check on gaskets. 5) Test for uniformity of galvanization.			
8.00.00	COMMISSIONING			
8.01.01	The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers.			
8.01.02	Cables a) Check for physical damage b) Check for insulation resistance before and after termination/jointing. c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning. d) Check of continuity of all cores of the cables. e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor. f) Check for correct polarity and phasing of cable connections. g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc. h) Check for provision of correct cable tags, core ferrules, tightness of connections.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.02.00	Cable trays / supports and accessories 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories. 2) Check for continuity of cable trays over the entire route. 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports. 4) Check for earth continuity and earth connection of cable trays. Earthing and Lightning protection system 1) Earth continuity checks. 2) Earth resistance of the complete system as well as sub-system.			
8.03.00				
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	ELEVATORS (ELECTRICALS)			
1.00.00	CODES AND STANDARDS	IS:4722, IS:325		
2.00.00	ELECTRICAL CONTROL SYSTEM	It shall be of variable voltage variable frequency (VVVF) control system having three phase induction motor.		
3.00.00	MOTORS	Motors shall be rated for frequent starting, S4 duty class as per IS4722 with CDF 40% and 150 starts per hour at 50 deg.cen. ambient.		
4.00.00	CAR ELECTRICAL ACCESSORIES	The following accessories shall be provided: i) Recessed fluorescenet light fittings for illumination level of 100 lux on car floor. ii) Portable light and alarm bell with battery and charger ventilation fan with control. iii) Car control station with position indicator inside the car and at landing platforms. iv) Emergency stop switch. v) 3 pin plug socket with switch on top of lift car. vi) Hand free speaker telephone set connected to plant network.		
5.00.00	POWER SUPPLY	Each elevator shall be provided with a separate three phase, three wire 415V feeder of adequate rating		
6.00.00	OTHER REQUIRIEMENTS	The control panels, cables & cabling, earthing, and other accessories & hardware shall conform to the requirements given in other sub-sections of this specification. However trailing cables of proven type as		
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	per standard practice of elevator manufacturer shall also be acceptable. The degree of protection of control panel shall be IP-52 for pressurised dust proof machine room and IP21 for air conditioned machine room as specified in mechanical specification. Necessary safety interlocks / devices shall be provided to ensure passenger safety.			
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	VFD FOR ID FAN			
1.00.00	GENERAL			
1.01.00	CODES AND STANDARDS			
	HT breaker	IEC:56		
	DC reactor	IEC 289		
	Motor	IS:4722/IS:325/IEC:60034		
	Transformers	IS:2026,		
	Bushing's	IS: 2099, IEC 137		
	Bushing CTs	IS: 2705, IEC :185		
	Insulating oil	IS:335		
1.02.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment. However VFD system power/control panels shall be located in air conditioned room.			
1.03.00	All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
1.04.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services.			
1.05.00	All the equipment, material and systems shall, in general, confirm to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.			
1.06.00	Paint shade shall be as follows			
	a)	VFD transformer	:	RAL 5012 (Blue), legend in black letter
	b)	Motors	:	RAL 5012 (Blue)
	c)	VFD Panels	:	Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)
	d)	VFD reactor	:	RAL 5012 (Blue), legend in black letter
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC	
1.07.00	Technical requirements of cables etc., which are not covered in the following clauses, shall be as described in relevant chapters of "Technical requirements , part-B .		
2.00.00	TYPE The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type.The system shall be of minimum 12 pulse design having 2 x 100 % channels for each motor.		
3.00.00	OPERATIONAL REQUIREMENTS The system shall be suitable for linear continuous speed control for a range indicated elsewhere as per the requirement of driven equipment. The system shall meet the requirements of IEEE 519 for the harmonics generated at the input of VFD transformer and transferred to power supply bus. All required protections like Overload, Earth fault, Over voltage, Over speed, Negative sequence, Field failure, Excitation faults etc as required and applicable for the system shall be provided.		
4.00.00	DESIGN AND CONSTRUCTION FEATURES System shall include the following equipment for each fan a) Power/control panels consisting of line converters , load converters and control system for drive control & protection. These shall be provided for each channel separately. b) Power transformer on the source side for each channel. c) Breaker/Contactor on the motor side for each channel. d) DC air core reactor or capacitor for each channel as per the system requirement. e) Motor f) LT power & control cables / cabling as mentioned elsewhere. g) MMI (Man machine Interface)		
4.01.00	Power Transformer 1) TYPE Out door type, Mineral oil filled ONAN type, Three phase unit, suitable for rectifier duty.		
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	2) RATING a) The Transformers shall be sized so as to have 10% margin at ambient conditions after considering final load requirements at peak conditions. The vector group of channel-I transformer shall be Ddo and the vector group of channel-II transformer shall be either Dyn1 or Dyn11 which shall be informed to the Contractor during detail engineering. b) The voltage rating of primary winding shall be 6.6 KV ,+/- 6%. The secondary voltage rating shall be decided by the Contractor to suit his system. 3) MAX. TEMPERATURE RISE WINDING 55°C above ambient 50°C Top OIL 50°C above ambient 50°C 4) OPERATIONAL REQUIRTEMENTS Tap Changer Off-circuit, +/-5% in steps of 2.5% shall be provided. It shall be hand operated by an external handle with position markings, pad locking facility in each position and mechanical stops to prevent over cranking beyond extreme positions. 5) Loading Capability Continuous operation at rated KVA on any tap with voltage variation of +/- 10% corresponding to the voltage of the tap as well as in accordance with IEC 354/IS: 6600. 6) Flux Density Not to exceed 1.9 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following overfluxing conditions due to combined voltage and frequency fluctuations: a) 110% continuous b) 125% for at least one minute. c) 140% for at least five seconds.			
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	7) Noise Level Not to exceed values specified in NEMA TR-1. 8) FEATURES All transformers shall be suitable for cable termination. A dust proof cable box with IP-55 degree of protection shall be provided. Also, a sheet steel, vermin and dust proof marshalling box shall be furnished with each transformer to accommodate temperature indicators, terminal blocks for control cables etc. The transformer shall be provided with all fittings and accessories to be complete in all respects for satisfactory operation. a) Tank Shall be fabricated from tested quality steel and designed to withstand continuous internal pressure of 35KN per sq.m. over normal pressure as well as short circuit forces. The main tank body including tap-changer compartment, radiators and coolers shall be capable of with standing full vacuum. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil insoluble insulating varnish. Tank shields, if provided, shall not resonate at natural frequency of equipment. b) Tank mounting Transformer tank shall be mounted on bi-directional rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer. Tank shall also be provided with lifting lugs and minimum four jacking pads. c) At least two adequately sized inspection openings, one at each end of the tank for easy access to bushings and earth connections shall be provided. d) Core shall be High grade non-aging cold rolled grain oriented silicon steel laminations. e) Winding conductor shall be Electrolytic grade copper. Windings shall be uniformly Insulated. f) Conservator tank of adequate capacity for expansion of oil from min. ambient to 100 deg.C, oil temperature shall be provided. The transformers rated 8MVA and above shall be provided with air bag breathing through silica gel breather. For lower rating transformers, conventional single compartment conservator with dry air filling the space above oil and connected to silica gel breather shall be provided.			
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4.02.00	g) Bushings shall be Porcelain. h) Bushing CTs Shall be provided in the LV neutral side of adequate rating for WTI. i) Radiators shall be Tank mounted with shut off valves. j) Insulating oil shall conform to IS: 335. No external inhibitors are permitted. k) Marshalling box shall be provided with thermostatically controlled space heaters and shall suitable for IP-55 degree of protection. l) Additional L.V. neutral bushing shall be brought out for earthing at equipment end. m) Fittings Shall be provided with following fittings i) Buchholz relay shall be provided with double float type with alarm and trip contacts. ii) A spring operated pressure relief devices with extension pipe to bring oil to plinth level alongwith electrically insulated contact for alarm and tripping shall be provided for transformer rating 2MVA and above. iii) Diaphragm type explosion vent shall be provided for transformers of rating less than 2MVA. iv) Winding temperature indicator (WTI) and Oil temperature indicator (OTI), Dial type (150mm) with alarm and trip contacts and max. reading pointer along with resetting device shall be provided. v) Magnetic oil level gauge with alarm contact shall be provided. vi) Oil level gauge Prismatic/toughened glass type. vii) Oil Temperature indicator (OTI)			
	Breaker/Contactor 1) Type Shall be SF6 or Vacuum type, restrike free, stored energy operated and with electrical anti-pumping features.			
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4.03.00	These shall be electrically operated, mechanically latched type & shall have protection against over load, all AC/DC transients and voltage surges etc. Electronic control module shall be electrically isolated from these power switching devices 2) TEMPERATURE RISE Temperature rise of busbars shall not exceed 55 deg. C for silver plated joints and 40 deg. C for other joints, over an ambient temperature of 50 deg. C under any condition. 3) CT/PT/Meters As required for the system offered & shall be suitable for variable frequency operation. A) DC Reactor (As applicable) 1) Type Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously and housed in metal enclosure fabricated from cold rolled sheet steel of Frame thickness 2.0 mm, Enclosure thickness 1.6 mm & Gland plate thickness 4.0 mm(Al). Enclosure degree of protection shall be IP-22. 2) Insulation :Class 'F', temperature rise is limited to Class-B 3) Noise level shall not exceed value specified in NEMA TR-1 B) Capacitor (As applicable) Shall be of self healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have discharge resistors which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.			
	4.04.00 Power Controller 1) Housing Metal enclosure panel having IP-21 degree of protection, located in air-conditioned Indoor environment fabricated from cold rolled sheet steel of Frame thickness 2.0 mm, Enclosure thickness 1.6 mm & Gland plate thickness 4.0 mm (Al).			
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	2) Control Any one channel (selectable) shall be in master mode in active operation. Other channel follows master in slave mode, with smooth changeover in the event of failure of master without initiating fan trip. Protections shall be provided against overload, AC/DC transients, voltage surge, etc. of power & control device Duplicate control supply with automatic changeover shall be provided. 3) Construction Proper ventilation shall be provided in the panels to ensure that max. temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system. In case cooling fans are provided, the same shall have 100% redundancy with provision for auto start of stand-by fan. The noise level inside the room with all channels operating shall be within the specified limit. 4) Man machine interface with one 21" CRT with keyboard and colour laser printer located in control room and one panel mounted printer for system alarm and monitoring. Provision shall be kept for exchange of information between VFD control system and DDCMIS .			
5.00.00	MOTORS a) Type 3 Phase Synchronous or 3 phase squirrel cage Induction motor suitable for VFD application b) Motors shall meet the requirements mentioned in subsection for motors and relevant IS/IEC			
6.00.00	TYPE TESTING			
6.01.01	The contractor shall carry out the type tests as listed in the "LIST OF TESTS TO BE CONDUCTED" on the equipment mentioned therein. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Owner's Engineer.			
6.01.02	The type tests shall be carried out in presence of the Owner's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Owner's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters,			
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	interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
6.01.03	Irrespective of the requirement of conducting the type tests under this contract, the Contractor shall submit the reports of the type tests as listed in the “LIST OF TESTS TO BE CONDUCTED” and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Owner reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Owner.			
6.01.04	Further the Contractor shall only submit the reports of the type tests as listed in the “LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED” and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.			
6.01.05	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
6.02.00	LIST OF TESTS TO BE CONDUCTED			
6.02.01	The following type tests shall be conducted under this contract a) VFD panels i) Temperature rise test ii) Surge withstand capability test iii) Noise level test b) Reactor (If applicable) i) Lightning impulse test ii) Heat run test			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	iii) Short time current test iv) Noise level test c) Transformer The following type tests shall be conducted on one transformer i) Tank Pressure test ii) Tank vacuum Test iii) Short circuit test on one transformer to be selected by owner. iv) Noise level v) Measurement of harmonics of no load current vi) PRD operation test vii) Degree of protection test on marshalling box viii) Zero sequence Impedance (not applicable for Delta-delta transformer) ix) Temperature rise test x) Lightning impulse test on one limb xi) DGA test on oil before and after temperature rise test d) Synchronous Motors (If applicable) Following tests shall be conducted for each type & rating of motors i) Tan delta and capacitance measurement ii) Measurement of noise at no load. iii) Vibration measurement during open circuit heat run iv) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.			
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6.03.00	v) Surge withstand test on sample coil after placing it in stator core at (4U+5KV) and with at least 5 impulse of 1.2/50 micro sec. Wave, for HV motors only ,where U is line to line voltage in KV. vi) Surge withstand test at sixty five percent value of (4U+5KV) with 0.3/3 micro sec. Wave on motor coils with at least 5 such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out the turns suitably. The power frequency test voltage shall be decided during detailed engineering. vii) Over speed test. e) Induction motors (if applicable) As per requirements mentioned in subsection for motors LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED a) Test reports for the following type tests shall be submitted for the synchronous motor (if applicable). i) Degree of protection test for the enclosure followed by IR, HV and no load run test. b) In case Induction motors are offered, then type test report requirements mentioned in sub section for motors shall be met.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ESP ELECTRICAL PORTION			
1.00.00	GENERAL			
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.			
1.02.00	All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5% and 10% combined variation of voltage and frequency unless specifically brought out in the specification. 415V AC supply voltage variation shall be +/- 10%.			
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services.			
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.			
1.05.00	Paint shade shall be as follows a) TR set : RAL 5012 (Blue), legend in black letter b) Motors : RAL 5012 (Blue) c) Panels : Front and rear panels in Grey(RAL9002). End panel sides in blue (RAL 5012)			
1.06.00	Technical requirements of ESP Electrical equipment like motors, cables, ACP/MCC etc. , which are not covered in the following clauses, shall be as described in relevant chapters of "Technical requirements (Electrical systems)" subsection .			
2.00.00	TRANSFORMER RECTIFIER SETS			
2.01.00	CODES AND STANDARDS Transformers shall conform to IS:2026. All other equipment / accessories shall conform to relevant Indian Standards. Equipment conforming to equivalent International Standard like IEC shall also be acceptable. The transformer oil shall meet the fire safety requirement specified in paragraph 450-23 of National Electrical Code.			
2.02.00	EQUIPMENT DESCRIPTION Type Silicone oil filled, free standing transformer rectifier assemblies in steel housing with HV disconnect and ground switch for each section of the ESP field. The sets shall be mounted on top of precipitator.			
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2.03.00	Tank	Welded type construction. Tank cover shall be sloped to prevent retention of water. Shall be provided with bi-directional skids, lifting lugs and four jacking pads.			
	Core	High grade non aging cold rolled grain oriented silicon sheet steel laminations.			
	Winding	Electrolytic grade copper.			
	Oil/ Oil Preservation	The transformer oil shall be non toxic and shall have high flash point (above 300 ⁰ C). Sealed type construction without breather.			
	LT Connection	Cable. Degree of protection of cable box IP: 54.			
	Bushings	Porcelain.			
	Marshalling box	Degree of protection IP-54, provided with thermostatically controlled space heaters.			
	Each TR set controller panel shall have isolating switch, power contactor, thermal overload relay, fuses for protection of SCRs etc				
	Fittings				
	Temperature Indicator	Dial type oil temperature indicators with alarm and trip contacts.			
2.04.00	Drip Tray	Shall contain total volume of cooling fluid. Drip trays shall be connected to a separator chamber through drain pipes. The separator chamber located at ground level shall be sized to contain oil from drainage of any two TR sets.			
	Pressure Relief Device	Shall be of spring loaded type.			
	Oil level indicator	Magnetic with low level alarm contact.			
	Oil level gauge	Prismatic/ toughened glass.			
	Buchholz relay	Shall be of double float type with Alarm and Trip contacts.			
	Operating Conditions				
	Operation of precipitator shall not be affected when one rectifier unit is taken out of service.				
	Flux Density	Flux density should not exceed 1.9 Wb/ sq.m. in the entire voltage variation range.			
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	V/F Shall be designed for 1.1 continuous. Noise Level Shall not exceed values specified in NEMA-TR-1. Protection Suitability for working under transient sparking conditions & occasional short circuit load. Protection against surge, excess temp. rise & under voltage to be provided.	
3.00.00	ESP INSULATORS High voltage insulator shall be located outside the gas stream, suitably housed in the insulator compartments to facilitate maintenance when the precipitators are on load. Each insulator compartment shall be provided with insulator heaters or hot air ventilation system to avoid moisture condensation on insulators. In case of hot air system, it shall include fans, air filters, heaters etc. The insulator compartment shall be provided with thermal insulation. The compartment shall be designed such as to prevent ingress of flue gas into compartments. Insulators for supporting emitting frame and roof bushing shall be of porcelain suitable for long life, in ESP internal environment (highly polluted with flue gas temp. of 200 deg. C and going upto 300 deg. C for 5 minutes). Insulators and disconnecting switch shall be suitable for AC rms one minute dry power frequency withstand voltage level and lightning impulse voltage level as indicated at cl no. 6.01.05 of this sub section.	
4.00.00	ESP EARTHING SHIELDING & SAFETY INTERLOCKS	
4.01.00	EARTHING & SHIELDING a) A complete earthing system with double path to the ground for all equipment and ESP structure shall be furnished. Each casing shall be provided with two earthing pads located on diagonally opposite corners of each casing. The pad surfaces shall be tinned drilled and shall be connected to Employer's earthing mat by 50x6 galvanised steel flats. b) Manual safety earthing switches shall be furnished so that individual equipment can be grounded during maintenance. All access doors, gas distribution baffles or perforated plates located in the inlet or outlet nozzles of the precipitators shall have ground straps connected to the precipitators casing if they are not welded permanently to the casing. c) In case special earthing requirement is needed for electronic cabinets the same shall be furnished by the Bidder.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.00	SAFETY INTERLOCKS			
	a) Contractor shall provide a full proof manual key sequence type interlock system for the safety of operating personnel from contacting energised high voltage equipment. Key interlocks shall be provided such that for a particular ESP casing any TR set cannot be energised until all insulator housing compartments, disconnect switch boxes, casing inspection doors are locked and emitting and collecting electrode rapping motors are prevented from energisation. Also it shall prevent opening of any inspection door unless all TR sets of that stream are de-energised and all HV disconnect switches are opened to earthed position. Rapping motors operation shall be prevented under this condition unless interlock is specifically defeated for testing. b) Key interlock system shall be simple, robust, weather proof in construction suitable for outdoor mounting and positive in action. It shall be suitable for high degree of repeatability without wearing out.			
5.00.00	ESP CONTROL SYSTEM			
	The control system shall be designed for automatic as well as manual local / remote operation. ESPs serving one boiler shall be provided with a complete control system consisting of microprocessor based EPMS, T/R set controllers, rapper controllers, communication controllers, hopper heater controls, insulator heaters and pressurization system controls and all other controls required for safe, efficient and reliable operation.			
5.01.00	ELECTROSTATIC PRECIPITATOR MANAGEMENT SYSTEM (EPMS)			
	The EPMS shall be connected to the Transformer Rectifier Set Controllers (TRC) and Rapper Controllers (RPC) through duplicate data highway. However, bidder's standard, proven system of communication through balanced current loop is also acceptable. EPMS shall accept the feed back analog signals like Boiler Load Index and Output from opacity monitors, process these signals and issue control parameters to the TR Controllers and Rapper Controllers. It shall also control, monitor and display the status of each stream i.e. status of TR Controllers, Rapper Controllers, hopper heaters, hopper levels, insulator heaters/pressurization air blowers etc. Hopper heater control achieved through suitable thermostats is also acceptable. The EPMS shall include, but not be limited to, the following features : (a) A PC based master controller with non-volatile memory and report storage capabilities for a period of 6 months. (b) TR set controllers and Rapper Controllers. (c) High resolution 21" colour CRT.			
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	(d) Communication ports and protocol for data transfer between EPMS Master control unit and the TRC/RPC/other controllers. (e) Keyboard for operator interface. (f) Color inkjet printer for alarms and reports (g) Facility for Auto operation of ESP with Energy Management (h) Necessary Input / Output points for interfacing with distributed digital controls and Management information system (DDCMIS). (i) Self surveillance and self diagnostic features. The EPMS display unit shall display at least the following : (a) A summary of the status of all the controllers. (b) A summary of the readings of all the TR sets. (c) A summary about each TRC i.e., settings, limits, voltage and current readings, alarms and the controller status. (d) A summary of each RPC i.e. controller status, rapping frequency, alarms and indication of the rapper being operated. (e) Status reading Energy Management System such as charge ratio of each field etc. (f) Necessary alarms as decided during detail engineering stage. (g) Status of hopper level, hopper heaters and insulator heater/blower (h) ESP TR set power supply status and alarm (i) Potential free contact for ESP trouble shooting etc. as required shall be provided. The PC based master controller i.e. operating and monitoring station together with 21" colour CRT, keyboard and colour inkjet printer shall be located in the Employer's unit control & equipment room/ programmer's room for each unit.		
5.02.00	Microprocessor Based Transformer - Rectifier (T/R) set controllers Each Transformer rectifier set shall be provided with a separate microprocessor based controller (TRC) for regulation and control of the electric power input to electrostatic precipitator fields. The EPROM shall be designed to obtain charge ratios minimum 1:99. It shall automatically optimise the charge ratio and maintain the spark rate at a suitable level for variations of gas temperature, dust composition, gas		
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	flow etc. It shall regulate the rectifier in such a way, that the current through the electrostatic precipitator is corrected as the conditions for sparking are changed. It shall be able to monitor filter functioning and shall give an alarm when values are lower or higher than set. It shall automatically regulate the charge ratio of each field/TR set based on V-I characteristics of the respective electrical fields. It shall have alternative arrangement of optimising the charge ratio based on Opacity Monitor signal Also. The controller shall have proven noise immunity and shall be suitable for ESP application. It shall be capable of maintaining the optimum voltage and current in ESP under all regimes of boiler operation. The system shall have the following features (but not limited to) : (a) Display unit for : (i) All the operating values like field DC voltages and currents. (ii) Spark rate (iii) Semi pulse current limit (iv) Voltage low limit (v) Charge ratio (vi) All other adjustable parameters & limits (b) Keys for operator interface and potentiometers local control and adjustments. (c) Serial communication with protocol for communicating to EPMS. (d) Local/ Remote selection. (e) Spark counter. (f) Alarms as mentioned below i) T/R set oil level low. ii) T/R set temperature high. iii) AC current high. iv) Low DC voltage. v) High DC voltage. vi) Back corona.			
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5.03.00	vii) Management command failure. viii) TR set buchholz / PRV trip ix) TR set buchholz alarm Microprocessor based Rapper Controller (RPC) Each stream of ESP shall be provided with a separate, Microprocessor based Rapper Controller (RPC). However, bidder's field proven standard design of rapper controller integral to TR set controller is also acceptable. It shall have proven noise immunity and shall be suitable for ESP application. It shall control the sequence and frequency of operation of the rapping mechanisms of collecting and discharge electrodes of the different fields of the precipitator. The unit shall control and survey the operation of rappers in the ESP. It shall start and stop the rappers as programmed and shall give an alarm if a rapper fails. From the controller it shall be possible to start or stop manually each rapper, without interfering with the other rappers. The operation status of each rapper shall be indicated with LEDs on the rapper controller panel. It shall be possible to change the three timings (viz. start time, repetition time and run time), intensity (if applicable) and frequency of rapping independently for each rapper, without need for opening the panel or any alternation in programme. The range of rapping frequency available shall be upto 24 hrs. Additionally the rapper controller shall have at least fifty (50) nos. pre programmes sequences of rapping stored in its memory so that the operator can select any of them according to his judgement or the controller itself can choose them based on feedback from boiler load. In case one separate rapper controller is provided for each stream, one standby working rapper controller shall be provided so that in case of failure of any one of the working rapper controllers, the standby controller shall immediately and automatically take over the control functions of this rapping without affecting the operation of ESP. The system shall have the following features (but not limited to) : a) Display of all adjustable parameters, rapping modes, time settings and intensity of rapper/ group and rapper status, rapper alarm and controller alarms. b) Key board for operator interface. c) Local/ remote selection: In local mode all commands and adjustments shall be from RPC. In remote mode all commands and adjustments shall be from EPMS. d) Communication port with protocol for communicating with EPMS.			
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	e) Remote on/ off capability from EPMS. f) The controller address (field programmable), logic programmes and other adjustable parameters shall be stored in non-volatile memory and shall not be affected by power loss.			
6.00.00	TYPE TESTS			
6.01.01	The contractor shall carry out the type tests as indicated in the "LIST OF TYPE TESTS TO BE CONDUCTED ON EACH TYPE AND RATING" on the equipment mentioned there in. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Owner's Engineer.			
6.01.02	The type tests shall be carried out in presence of the Owner's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Owner's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
6.01.03	In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit the reports of the type tests indicated in the "LIST OF TYPE TESTS TO BE CONDUCTED ON EACH TYPE AND RATING" to the owner for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Owner reserves the right to waive conducting of any or all of the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.			
6.01.04	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
6.01.05	LIST OF TYPE TESTS TO BE CONDUCTED ON EACH TYPE AND RATING a) TR set 1) Temperature rise test at rated DC current at 1:1 charge ratio 2) Lightning Impulse voltage test 3) Jacking test on transformer load bearing member 4) Measurement of harmonic current in no load current			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-III-E-08 ESP ELECTRICAL PORTION PAGE 8 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	5) PRD operation test 6) Short Circuit Test (To be conducted as described below) This short circuit test shall be performed on TR set along with the TR panel and controller with a spark gap connected across the output. The gap is adjusted to get the spark at required peak voltage which is the short circuit condition and the controller will control the voltage to quench the spark. 7) Oil leakage test for 24 hours 8). Vacuum test on tank 9) Pressure test on tank 10) Induced over voltage test 11) Measurement of no load losses and current 12) Measurement of impedance voltage/ short circuit Impedance and losses 13) Measurement of IR 14) Measurement of acoustic sound level 15) Degree of protection test for transformer marshalling box. 16) Measurement of capacitance and tan delta b) Insulators 1). Compression test on support insulator 2). Torsion test on shaft insulator 3) Lightning impulse test and one minute dry power frequency test on each type of Insulators. For 300mm Electrode spacing ESP field - Lightning impulse test voltage shall be 170KVp and one minute dry power frequency test voltage shall be 70KVrms. For 400mm Electrode spacing ESP field - Lightning impulse test voltage shall be 250KVp and one minute dry power frequency test voltage shall be 95KVrms			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-E-08 ESP ELECTRICAL PORTION	PAGE 9 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	c) Disconnecting switch 1) Lightning impulse test and one minute dry power frequency test For 300mm Electrode spacing ESP field - Lightning impulse test voltage shall be 170KVp and one minute dry power frequency test voltage shall be 70KVrms . For 400mm Electrode spacing ESP field - Lightning impulse test voltage shall be 250KVp and one minute dry power frequency test voltage shall be 95KVrms.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-E-08 ESP ELECTRICAL PORTION	PAGE 10 OF 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
1.00.00	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS			
1.01.00	TYPE:			
1.01.01	The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). A 415, 3 phase 3 wire power supply shall be given to the actuator from vendor's/employer's switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.			
1.01.02	In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit is provided with coupling relays for 24 V DC command inputs.			
1.02.00	INTERFACES:			
1.02.01	Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator. (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided. Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system. (b) For Modulating Drive:- the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided (c) Open/close command termination logic shall be suitably built inside actuator.			
1.03.00	RATING : (a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%. (b) Sizing:- Open/Close at rated speed against designed differential pressure at 90% of rated voltage. For isolating service:- Three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-E-09 ELECTRICAL ACTUATORS	PAGE 1 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.04.00	CONSTRUCTION: (a) Enclosure: Totally enclosed weatherproof minimum IP-55 degree of protection. (b) Gear Train : Metal (Fibre gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energized. (c) Manual Wheel: Shall disengage automatically during motor operation.			
1.05.00	MOTOR : (a) Type : Squirrel cage induction motor suitable for Direct On Line (DOL)starting. (b) Enclosure: Totally enclosed, self ventilated IP-55 degree of protection. (c) Insulation Class B or better. Temperature rise 70 Deg C. over 50 Deg C ambient (d) Bearings: Double shielded, grease lubricated antifriction. (e) Earth Terminals: Two (f) Protection: Single Phasing Protection, Over heating protection through Thermostat and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design Suitable means shall be provided to diagnose the type of fault locally.			
1.06.00	POSITION/TORQUE SWITCHES:			
1.06.01	Four nos. (2 each in open and close position) position limit switches and two nos. (one in open and other in close direction) torque switches each having two nos. NO			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-E-09 ELECTRICAL ACTUATORS	PAGE 2 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	and two nos. NC contacts shall be provided. A single shaft shall actuate all contacts of limit switches at each position. Limit switch and disturbance signals shall be available to DCS even when the power supply to the actuators is not available. Torque switches shall be bypassed in both the end positions with the other end Limit switches. Limit switches Limit switches shall be Silver plated with high conductivity and non –corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55.		
1.07.00	LOCAL OPERATION:		
1.07.01	It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.		
1.08.00	POSITION INDICATOR :		
1.08.01	To be provided for 0 to 100% travel.		
1.09.00	POSITION TRANSMITTER (FOR MODULATING/INCHING TYPE) :		
1.09.01	As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, 24 volts DC operated.		
1.10.00	WIRING :		
1.10.01	Suitable voltage grade copper wire.		
1.11.00	TERMINAL BOX :		
	(i)9 pin plug and socket (1 no. per actuator to suit 4 pair 0.5 sq.mm. copper overall shielded (16 mm OD), instrumentation cable) suitably mounted in the starter box itself to terminate open/close command and status feedback signals with external control systems. (ii)Additional one number 9 pin plug and socket (to suit 4 pair 0.5 sq.mm copper (16 mm OD) individual and overall shielded instrumentation cable) suitably mounted in the starter box itself for actuators with 4-20 mA position transmitters. (iii)Necessary glands for power cables shall be provided.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
1.12.00 1.12.01 1.13.00 1.13.01 1.14.00 1.14.01	TERMINAL BLOCK : 650V grade. For power cables. SPACE HEATER : Space heater of suitable rating. The supply shall be derived from the main power supply available in the actuator. TYPICAL WIRING DIAGRAM : Refer Tender Drawing No. 0000-999-POI-A-063.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-III-E-09 ELECTRICAL ACTUATORS	PAGE 4 OF 4	

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																				
	ANNEXURE-EQ CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1):2002 and IS:1893 (Part 4):2005. Pending finalisation of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Annexure-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Annexure-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a)</td><td>Steel structures</td><td>:</td><td>2%</td></tr><tr><td>b)</td><td>Reinforced Concrete structures</td><td>:</td><td>5%</td></tr><tr><td>c)</td><td>Reinforced Concrete Stacks</td><td>:</td><td>3%</td></tr><tr><td>d)</td><td>ND Cooling Towers</td><td>:</td><td>2%</td></tr><tr><td>e)</td><td>Steel stacks</td><td>:</td><td>2%</td></tr></table>				a)	Steel structures	:	2%	b)	Reinforced Concrete structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	ND Cooling Towers	:	2%	e)	Steel stacks	:	2%
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1). For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Annexure-I. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-V CIVIL WORKS ANNEXURE-EQ	PAGE 31 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ANNEXURE – I <u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES</u> <u>AND EQUIPMENT</u> The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration (MCE) : 0.38g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.111 b) for braced steel frames designed and detailed as per IS:800 : 0.083 c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.067 d) For steel chimney : 0.167 e) for design of structures not covered under 2 (a) to 2 (d) above and under 3 below : 0.111 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.22 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.			
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	HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS (In units of ‘g’) <table><tr><th rowspan="2">Time Period</th><th colspan="2">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>2%</th><th>5%</th></tr><tr><td>(Sec)</td><td></td><td></td></tr><tr><td>0.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.030</td><td>1.000</td><td>1.000</td></tr><tr><td>0.031</td><td>1.029</td><td>1.019</td></tr><tr><td>0.050</td><td>1.568</td><td>1.349</td></tr><tr><td>0.060</td><td>1.840</td><td>1.501</td></tr><tr><td>0.070</td><td>2.108</td><td>1.643</td></tr><tr><td>0.080</td><td>2.371</td><td>1.777</td></tr><tr><td>0.086</td><td>2.526</td><td>1.854</td></tr><tr><td>0.088</td><td>2.578</td><td>1.879</td></tr><tr><td>0.090</td><td>2.629</td><td>1.904</td></tr><tr><td>0.095</td><td>2.758</td><td>1.965</td></tr><tr><td>0.098</td><td>2.834</td><td>2.001</td></tr><tr><td>0.100</td><td>2.885</td><td>2.025</td></tr><tr><td>0.103</td><td>2.961</td><td>2.060</td></tr><tr><td>0.108</td><td>3.087</td><td>2.118</td></tr><tr><td>0.110</td><td>3.137</td><td>2.141</td></tr></table>				Time Period	Damping Factor (as a percentage of critical damping)		2%	5%	(Sec)			0.000	1.000	1.000	0.030	1.000	1.000	0.031	1.029	1.019	0.050	1.568	1.349	0.060	1.840	1.501	0.070	2.108	1.643	0.080	2.371	1.777	0.086	2.526	1.854	0.088	2.578	1.879	0.090	2.629	1.904	0.095	2.758	1.965	0.098	2.834	2.001	0.100	2.885	2.025	0.103	2.961	2.060	0.108	3.087	2.118	0.110	3.137	2.141
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	ANNEXURE – I			
	<u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS</u>			
	<u>(In units of ‘g’)</u>			
	Time Period	Damping Factor (as a percentage of critical damping)		
	(Sec)	2%	5%	
	0.597	3.880	2.570	
	0.603	3.880	2.570	
	0.609	3.880	2.570	
	0.615	3.880	2.570	
	0.625	3.880	2.570	
	0.645	3.880	2.570	
	0.658	3.880	2.570	
	0.667	3.880	2.570	
	0.670	3.880	2.570	
	0.690	3.880	2.570	
	0.700	3.880	2.570	
	0.750	3.621	2.570	
	0.755	3.597	2.552	
	0.800	3.395	2.409	
	0.850	3.195	2.267	
	0.900	3.018	2.141	
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SUB SECTION - V

DETAILED TECHNICAL SPECIFICATION

(CIVIL WORKS)

SUB SECTION – VI

PRE-COMMISSIONING

CLAUSE NO.	CIVIL WORKS
1.00.00	GENERAL
1.01.01	This section of the Technical Specification covers the technical requirements for Design, preparation of General Arrangement Drawings, Design Drawings, Civil task drawings (for engineering by Employer for areas covered under Employer's scope), Supply of Labour, Materials, plant & equipment, Construction, fabrication and Erection of Civil and Structural works included in Contractor's scope.
1.01.02	Description of various items of work under this Specification and nature of work in detail are given hereinafter. The complete works under this Specification is referred to as "Civil Works". Various Structures, Plant, Systems, Facilities, etc., covered under the Scope of this Specification is given in Part - A and herein.
1.01.03	The work to be performed under this Specification shall also include Design, Engineering and providing of all Labour, Materials, Plant & Equipment, Consumables, Construction Facilities and all Incidental Items though not shown or specified but are reasonably implied and / or are necessary for the completion and proper functioning of the Plant, Systems and Facilities, all in strict accordance with the Specifications, including revisions and amendments thereto.
1.01.04	All Materials required for works under the Contractor's scope shall be arranged and supplied by the Contractor.
1.01.05	All support structures (as covered under the Scope) including those for pipes/cables/ducts above Foundation Level or Grade Level, whichever is lower shall be of Steel and shall be supplied and provided by the Contractor.
1.01.06	All interconnecting platforms shall be supplied and provided by the Contractor.
1.01.07	All mono-rails, monorail beams required for equipment handling, etc. shall be supplied and provided by the Contractor.
1.01.08	Foundation Bolts along with templates, inserts and embedments along with lugs, pipe sleeves, etc. whatsoever required in concrete/masonry for supporting Equipment and Structures shall be supplied by the Contractor and placed by Employer. However the accuracy of these fixtures shall be checked and ensured by the Contractor during placement. Any modification required on these fixtures subsequent to their placement shall be done by Contractor.
1.01.09	Steam Generator, ESP and FGD Structure shall be supported by Contractor on Foundation through Foundation Bolt assemblies installed at the time of first stage concreting.
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CLAUSE NO.	CIVIL WORKS		
1.01.10	All other Structures shall be supported by Bidder on Foundation through Anchor Fasteners. For such Structures, Employer shall provide the Foundation, on which the Contractor shall supply and install, the Anchor Fasteners of requisite capacity to support his Structures.		
1.01.11	Anchor Fasteners shall be used for supporting all such Equipment, where the Static and Dynamic Load due to Equipment is within the safe Load carrying capacity of the Anchor Fasteners. For such Equipment, Employer shall provide the Foundation, on which the Contractor shall supply and install the Anchor Fasteners of requisite capacity to support his Equipment.		
1.01.12	The Employer shall provide the pockets only for those Equipment Foundations where the Load to be transferred is beyond the safe Load carrying capacity of Anchor Fasteners. For such Equipment, subsequent supply and installation of Foundation Bolts including Grouting of pockets shall be done by Contractor. In case, it is required that Foundation Bolts are required to be embedded during the first stage of concreting, then the Contractor shall make the Bolts available at site (before casting of foundation) for installation by Employer at the time of the concreting stage itself. During concreting, Contractor shall depute his engineers to verify that all foundation bolts/sleeves/embedments etc. are installed correct to layout and levels as per their design drawings. Any modification required on these fixtures subsequent to their placement shall be done by Contractor.		
1.01.13	All inserts and embedments whatsoever required by the Contractor over the Concrete, masonry and other similar surfaces, for supporting their Structures/ Equipment etc. shall be installed by the Contractor using Anchors Fasteners. All small size Openings having size (within 150 mm x 150 mm area) which are required on Floors, Walls, Cladding, Roof etc. shall be neatly created and finished by the Contractor using appropriate tools. The Employer shall however provide larger size Openings.		
1.01.14	All Grouting of pockets, Underpinning of Base Plates, filling and finishing of Openings etc. shall be done by the Contractor. The Employer shall do encasement of Base Plates. Anchor Fasteners shall be fixed in position by Contractor as recommended by the manufacturer and approved by the Employer.		
1.01.15	The work shall be carried out according to the Design / Drawings, to be developed by the Contractor and got approved by the Employer. For all Plant, Systems, Facilities, Structures, etc., necessary Layout and details are to be developed by the Contractor keeping in view the statutory and functional requirements and providing enough space and access for Operation, use and Maintenance. The Contractor's work shall cover satisfying the complete requirements as per IS Codes, requirements of various Statutory Bodies,		
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CLAUSE NO.	CIVIL WORKS			
	International Standards, best prevailing practices and to the complete satisfaction of the Employer.			
1.01.16	The Contractor shall make the Layout and Levels of all Structures from the general grid of the plot and the nearest GSI Benchmark or other acceptable Benchmark of Government Department, as per the directions of the Employer. The Contractor shall be solely responsible for the correctness of the Layout and Levels and shall also provide necessary instruments, manpower, materials, access to works, etc., to the Employer for general checking of the correctness of the Civil works.			
1.01.17	All the quality standards, tolerances, Welding standards and other technical requirements shall be strictly adhered to.			
1.01.18	The Contractor shall fully appraise himself of the prevailing conditions at the proposed Site, climatic conditions including monsoon pattern, soil conditions, local conditions and Site specific parameters and shall provide for all such conditions and contingent measures, including those which may not have been specifically brought out in the Specifications but required for successful execution of work.			
1.01.19	In case of any conflict between stipulations in various portions of the Specification, most stringent stipulation would be applicable for implementation by the Contractor without any extra cost to the Employer.			
2.00.00	SUBMISSIONS			
2.01.01	Commencement of Fabrication, Erection and Construction shall be done after approval of the relevant Design Documents and Drawings. All Drawings shall be of standard sizes (Metric System) and shall be made under AutoCAD, whereas all Documents shall be made either in MS Excel or in MS Word.			
2.01.02	The Design Documents and Drawings for the following areas shall be submitted for approval of the Employer. (a) Steam Generator and Auxiliaries (b) Electro Static Precipitator (ESP). (c) Power Cycle Piping consisting of MS, HRH, CRH and Auxiliary Steam Piping. (d) Mill Reject Handling System. (e) Auxiliary Boiler (f) FGD Structure			
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CLAUSE NO.	CIVIL WORKS			
2.01.03	The Design Documents and Drawings submitted by the Contractor shall contain at least the following Minimum information:			
	(a) General Arrangement for Equipment, Piping / Cables / Ducts.			
	(b) Loading Plans indicating Floor Imposed Loads, Equipment Loads, Piping/ Cables / Ducts Loads.			
	(c) Openings in Floor/ Walls / Cladding / Roof.			
	(d) Equipment Mounting Details (where Supporting Structures are provided by the Employer).			
	(e) General Arrangement of Foundations including Loading Data, Bolt Details, Pocket Details, etc.			
	(f) Insert Details, Anchor Fastener Details along with their General Arrangements.			
	(g) Project Design Intent Document covering Design Criteria including Loading assumptions, references, structural idealisation / Mathematical Model, Load Cases, Load Combinations, etc.			
	(h) Analysis and structural Design Calculations.			
	(i) 3-D Analytical Model of Structure.			
	(j) Details of Corrosion Protection Measures.			
	(k) Any other submission, as indicated elsewhere in this Specification and/ or as required by the Employer.			
3.00.00	DESIGN CRITERIA			
3.01.00	General			
3.01.01	The Design criteria given herein are applicable for all Structures.			
3.01.02	Structures shall be Designed for the most critical Combinations of Dead Loads, Imposed Loads, Equipment Loads, Crane Loads (if any), Pipe Loads (Static, Friction and Dynamic), Cable / Ducts Loads, Ash Loads, Dust Loads, Wind Loads, Seismic Loads, Temperature Loads, Erection Loads, Loads due to Differential Settlement, etc.			
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CLAUSE NO.	CIVIL WORKS
3.02.00	Material
	Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects.
3.02.01	Mild Steel a) Rolled sections and plates up to and including 20mm thickness shall conform to grade 'A' of IS: 2062 and shall be semi-killed. Plates beyond 20mm thickness shall conform to grade 'B' of IS: 2062 and shall be killed. All steel upto and including 40mm thickness shall be in as rolled condition. Plates beyond 40mm Thickness shall be normalized and ultrasonically tested. b) Pipes shall conform to IS: 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade A of IS: 2062.
3.02.02	Medium and High Tensile Steel a) Medium and high tensile steel shall conform to grade 'Fe-490B' of IS 8500 or equivalent. b) Rolled sections and plates up to and including 20mm thickness shall be semi-killed and plates beyond 20mm thickness shall be killed. c) All steels upto and including 40mm thickness shall be in as rolled condition. Plates beyond 40mm thickness shall be normalized and ultrasonically tested.
3.02.03	All other Materials shall be as per applicable Standards and Codes.
3.02.04	All Materials brought for incorporation in works shall be of best quality as per IS, unless specified otherwise.
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CLAUSE NO.	CIVIL WORKS																																							
3.03.00	Loading																																							
3.03.01	Dead Loads Dead Loads are permanent Loads which shall include the weight of Structure complete with finishes, fixtures, partitions, etc. and shall be taken as per IS:875 (Part-I).																																							
3.03.02	Imposed Loads (a) Imposed Loads in different areas shall include Live Loads, Erection, Operation and Maintenance Loads. (b) Equipment Loads (which constitute all Loads of Equipment to be supported, as given by Equipment Supplier), Pipe Loads (Static, Friction and Dynamic), Cable / Ducts Loads, Ash Loads, Dust Load, wherever applicable, are not included in the Imposed Loads as furnished below and these Loads shall be considered in addition to Imposed Loads. (c) For consideration of Imposed Loads on Structures, IS : 875 (Part 2) in general shall be followed. However, for the following areas, minimum imposed loads as indicated below shall be considered for the design. If the actual expected Imposed Load is more than the specified Minimum Imposed Load, then actual Imposed Load shall be considered. <table><tr><th>Sl.No.</th><th>Description</th><th>Minimum specified Imposed Loads (T / Sq. M.)</th></tr><tr><td colspan="3">-----</td></tr><tr><td>1.</td><td>Floors</td><td></td></tr><tr><td></td><td>i) Operating Floors</td><td>1.00</td></tr><tr><td></td><td>ii) Drum Floor</td><td>1.00</td></tr><tr><td></td><td>iii) Elevator Machine Room</td><td>1.00</td></tr><tr><td></td><td>iv) Maintenance Platforms</td><td>1.00</td></tr><tr><td></td><td>v) Any other Floors</td><td>0.50</td></tr><tr><td>2.</td><td>Roof / Penthouse</td><td></td></tr><tr><td></td><td>i) Non Accessible (with no Equipment)</td><td>0.075</td></tr><tr><td></td><td>ii) Accessible</td><td>0.150</td></tr><tr><td></td><td>iii) Dust Loads</td><td>Equivalent to 0.15M of Ash Deposit</td></tr></table>				Sl.No.	Description	Minimum specified Imposed Loads (T / Sq. M.)	-----			1.	Floors			i) Operating Floors	1.00		ii) Drum Floor	1.00		iii) Elevator Machine Room	1.00		iv) Maintenance Platforms	1.00		v) Any other Floors	0.50	2.	Roof / Penthouse			i) Non Accessible (with no Equipment)	0.075		ii) Accessible	0.150		iii) Dust Loads	Equivalent to 0.15M of Ash Deposit
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3.03.03	Equipment, Piping / Cables / Ducts and associated Loads The Equipment, Piping / Cables / Ducts and associated Loads shall be considered as given by the supplier. Equipment Loads, which are of permanent nature, shall be treated as Dead Loads.																																						
3.03.04	Seismic Loads All Structures shall be Designed for Seismic forces adopting the Site Specific Seismic information, as specified in Annexure-EQ to this Sub-Section of Specification.																																						
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3.03.06	Temperature Loads																								
	(a) For temperature Loading, the total temperature variation shall be considered as 2 / 3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily Minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The Structure shall be Designed to withstand Stresses due to 50% of the total temperature variation. (b) Suitable expansion joints shall be provided in the Longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS : 800 for Steel Structures. (c) Frictional forces due to temperature variation shall be considered between the Pipes and the supporting Structures along Longitudinal direction.																								
3.03.07	Ash Density																								
	(a) Following Ash density shall be considered for the Design : <table><tr><th>Sl.No.</th><th>Description</th><th>Density (Kg/Cu. M.)</th></tr><tr><td>a)</td><td>Bottom Ash for volume calculations</td><td>650</td></tr><tr><td>b)</td><td>Bottom Ash for Load calculations</td><td>1600</td></tr><tr><td>c)</td><td>Fly Ash for volume calculations</td><td>750</td></tr><tr><td>d)</td><td>Fly Ash for Load calculations</td><td>1600</td></tr><tr><td>e)</td><td>Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)</td><td>1000</td></tr><tr><td>f)</td><td>For ESP supporting Structures</td><td>1350</td></tr></table>				Sl.No.	Description	Density (Kg/Cu. M.)	a)	Bottom Ash for volume calculations	650	b)	Bottom Ash for Load calculations	1600	c)	Fly Ash for volume calculations	750	d)	Fly Ash for Load calculations	1600	e)	Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)	1000	f)	For ESP supporting Structures	1350
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3.03.08	Ash Loads (a) All ESP Hoppers filled up with ash upto the top of the Hopper/ partition plane or the bottom of electrodes (whichever is more) along with additional ash build-up from the end of the third field upto the inlet Duct bottom Level at a natural repose angle (not less than 30° to horizontal in any case) shall be considered for the Design of ESP supporting Structures. (b) Ash Load over Penthouse / Roof of Steam Generator / ESP shall be considered. (c) Ash Load in the flue gas Duct shall be taken considering it to be one fourth full with Ash.	
3.03.09	Differential settlement Loads Structures shall be Designed considering an additional Load on account of differential settlement of 1 in 1000 between any two adjacent columns, subject to a maximum differential settlement of 8 mm.	
3.03.10	Additional Loads due to Employer Facilities Following Minimum additional Loads supporting the Employers Facilities shall be considered in the Design of ESP / Steam generator Structures, for the supporting of the Employers Facilities. (a) Cantilever Loads of not less than 2000 Kg / M at a distance of 1200 mm from the external face of the columns, on both sides of the ESP, for Cable trays and Walkways. (b) Cantilever Loads of not less than 500 Kg / M at a distance of 1200 mm from the external face of the columns, on both sides of the Steam Generator, for Cable trays and Walkways. (c) Dry Fly Ash Piping Loads. (d) Ash Water Piping Loads. (e) Supply Ash and Instrument Air Piping. (f) Service Water Piping	
3.04.00	Design Concepts	
3.04.01	Individual members of the frame shall be Designed for the worst Combination of forces such as bending moment, axial force, shear force, torsion, etc.	
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3.04.02	The different Load Combinations shall be taken as per IS : 875 (Part - 5) and other relevant IS Codes. (a) Wind and Seismic forces shall not be considered to act simultaneously. (b) The Structures shall be Designed for most unfavorable Combination of Dead Loads, Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads, Wind / Seismic Loads, Temperature Loads, Ash Loads, and other applicable Loads without exceeding the Permissible Stresses. (c) Permissible Stresses for different Load Combinations shall be taken as per IS 800. (d) For checking against uplift / tension case, 75% of Dead Loads with no Imposed Loads shall be considered along with other Loads. (e) In all Loading Combinations, the Loads that have reduction effect on design condition shall not be taken into account in the Combination concerned. (f) Where Wind is the main Load acting on the Structure, no increase in Stresses is to be considered for Design of Structures and Foundation Bolts. (g) Dynamic Piping Loads need not be considered acting simultaneously with Wind or Seismic Loads. Increase in Permissible Stresses shall be allowed in Load Combinations where Dynamic Piping Loads are considered and shall be as permitted under Seismic Load conditions. (h) For the Design of ESP Supporting Structures for Seismic, Ash Load in Hoppers filled upto to the top of the Hopper or bottom of the electrode (whichever is higher) shall be considered as permanent Loads along with other applicable Loads. (i) For the Design of ESP Supporting Structures for Wind, Ash Loads as specified shall be considered as permanent Loads along with other applicable Loads.		
3.04.03	The Design of Steel Structures shall be done by Working Stress Method. Design shall be as per the provisions of IS : 800 and other relevant IS standards. For Design of Hoppers IS : 9178 Parts - I, II & III shall be followed.		
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3.04.04	Deflection Criteria The maximum Deflection for various Structures shall not exceed and be limited to the following: <table><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr><tr><td>1.</td><td>For all Structures</td><td>Span / 325 or Height / 325, as the case may be unless noted otherwise.</td></tr><tr><td>2.</td><td>For all beams directly supporting Equipment</td><td>Span / 500</td></tr><tr><td>3.</td><td>For all Purlin, Cladding Runners, Roofing / Cladding Sheets</td><td>Span / 250</td></tr><tr><td>4.</td><td>For all Grating / Chequered Plates</td><td>Span / 250</td></tr></table> (However, the maximum vertical Deflection of Grating / Chequered Plate shall be limited to 6 mm).				Sl. No.	Description	Maximum value of	1.	For all Structures	Span / 325 or Height / 325, as the case may be unless noted otherwise.	2.	For all beams directly supporting Equipment	Span / 500	3.	For all Purlin, Cladding Runners, Roofing / Cladding Sheets	Span / 250	4.	For all Grating / Chequered Plates	Span / 250
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3.04.05	All Structures of the Contractor shall be independent of Employer's Structures. In case any vertical Loads from the Contractor's Structures are required to be transferred to the Employer's Structures, the same shall be through PTFE bearings. In no case shall any horizontal Loads be transferred to the Employer's Structures from the Contractor's Structures.																		
3.04.06	Welding shall be used for fabrication and Erection. Site connections shall be with Welding / Bolts. For Bolt connection, IS : 4000, IS : 3757, IS : 6623 and IS : 6649 shall be followed. For Welding of Structures IS : 814, IS : 816, IS : 1024, IS : 4353 and IS : 9595 shall be followed. Other requirements pertaining to welding mentioned elsewhere in the specification shall also be satisfied by the Contractor.																		
3.04.07	Fans (ID, FD and PA) shall be supported on spring supported RCC foundation. The steel helical springs and viscous dampers shall be provided by the Contractor. However the RCC deck shall be provided by the Employer. The equipment supplied by Contractor shall be compatible for supporting on steel helical springs and viscous dampers.																		
3.04.08	Pipes, Cables and Ducts Supports (a) All Pipes, Cables and Ducts shall generally be routed above ground.																		
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	(b) A Minimum clearance (clear Headroom) of 8 m shall be kept for all over-ground Pipes / Cables / Ducts for all road / rail crossings. For other areas, the requirement of Minimum clearance shall be as specified elsewhere in the Specifications. All Pipes / Cables / Ducts supports shall be provided with continuous walkway of Minimum 750 mm Width with handrails and toe-guards, all along the length with approach ladders near roads, passageways, etc. Before and after the road / rail crossings, a barrier of suitable Height shall be constructed so as to prevent the approach of Cranes (having Height more than 8 m) etc., upto the Pipes / Cables / Ducts supports. (c) In case any main Steel framed Structure of the Employer is existing in close vicinity of the Contractor's Pipes / Cables / Ducts supports, support only from the main framing Structure of the Employer may be permitted by the Employer to the Contractor, for supporting his Pipes / Cables / Ducts. Levels and detail of such supports shall be finalised by the Contractor in consultation with the Employer during his detailed Engineering stage. The Contractor shall supply and provide all such supports.	
3.04.09	Whenever Contractor is taking any support from any of the Employer's Structures, the Contractor shall ensure that no damage is done, to the Employer's Structures including Painting thereof. In case of any damage to the Employers Structure and / or Painting, then the Contractor shall rectify the same to the complete satisfaction of the Employer.	
3.04.10	Supporting Structures shall be so configured that the temperature of Steel does not exceed 60°C unless specified otherwise.	
3.04.11	Each ESP Hopper shall be supported at Four Corners, by providing Four Columns. ESP Hopper outlet flanges shall be terminated at a Height of not less than 3.50 M above the Finished Paving Level.	
3.04.12	The bracing in Structures shall be provided such that under no circumstances normal / convenient access to any points is blocked or obstructed.	
3.04.13	Finished Floor Level of Steam Generator and ESP area Paving shall be kept 200 mm lower than the finished Floor Level of Main Plant Building.	
3.04.14	The Employer proposes to encase all Base Plates. Top of the encasement Concrete shall match with the surrounding finish Paving Level. All stiffeners provided with Base Plate shall also be fully encased and for this purpose the top Level of stiffeners shall be kept by Contractor at least 200 mm below the surrounding finish Paving Level.	
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3.04.15	Propping / supporting of any Beam on the bracing members shall not be permitted.	
3.04.16	All Structures close to railway line shall have clearance conforming to Railway norms.	
3.04.17	Penthouse / Roof shall be covered with troughed profile permanently colour coated Sheet. Site Cladding / Canopy shall also be with troughed profile permanently colour coated sheet.	
3.04.18	All Stairs shall have a maximum Riser Height of 180 mm and a Minimum Tread Width of 250 mm. Minimum clear Width of Stairs shall be 1200 mm, unless specified otherwise.	
3.04.19	Minimum headroom (free Height) under all Floors, walkways and Stairs shall be 2.30 M.	
3.04.20	Mill Bunker Building (in the Employer's Scope) shall be provided with bracing in both Longitudinal and Transverse directions. Contractor to route his Monorail, Maintenance Platforms, etc. and their supporting Structures accordingly. It may happen that Employer may not be able to provide bracing at certain elevations due to the constraints Imposed by the Contractor's monorail, Maintenance Platforms, supporting Structures etc. In such cases the Contractor shall Design and provide his supporting Structures by considering extra framing Loads from the Employer's Structure due to non-provision of bracing. Details of the same shall be finalised by the Contractor with Employer during detailed Engineering.	
3.04.21	All Foundation Bolts shall conform to IS : 5624.	
3.05.00	Electrodes	
3.05.01	The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium / high tensile steel and for mild steel plate thickness above 20 mm.	
3.05.02	All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.	
3.05.03	Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.	
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3.05.04	Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.	
3.05.05	Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.	
3.05.06	The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.	
3.06.00	Edge Preparation for Welding	
3.06.01	Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.	
3.07.00	Pre Heating and Post Heating	
3.07.01	Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.	
3.07.02	Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat temperature and this temperature shall be maintained as minimum inter-pass temperature while welding is in progress.	
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	TABLE - 1		
	MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL		
	Welding Using		
	Thickness of thicker part at Point of welding	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
	Upto and including 20mm	None	None
	Over 20mm and up to and including 40mm	20°C	Not allowed
	Over 40mm and up to and including 63mm	66°C	Not allowed
	Over 63mm	110°C	Not allowed
	Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.		
	TABLE - 2		
MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL			
Welding Using			
Thickness of thicker part at Point of welding	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	
Upto and including 20mm	None	Not Allowed	
Over 20mm	120°C - 140°C	Not Allowed	
Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.			
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3.07.03	Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.		
3.07.04	Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.		
3.07.05	All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600°C and rate of application shall be 200°C per hour.		
3.07.06	The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.		
4.00.00	STEEL HELICAL SPRINGS AND VISCOUS DAMPERS		
4.01.01	General Requirement		
4.01.02	This part of the specification covers the requirement for the manufacturing, testing, supply, transport to site, pre-stressing, erection, supervision of erection, release of pre-stress, alignment, commissioning, etc. of steel helical springs and viscous dampers.		
4.01.03	The steel helical springs and viscous dampers supplied should be of proven make.		
4.01.04	The information about the entire range of spring units, damper units and spring-cum-damper units manufactured by sub vendor shall be furnished to enable the owner to do the engineering of the foundations along with appropriate type of spring units for different machines. The information to be furnished should include the load carrying capacity, stiffness (vertical & horizontal), damping resistance, dimensions of spring and damper units.		
4.02.00	Codes and Standards		
	Some of the relevant applicable Indian standards and codes, etc, applicable to this section of the specification are listed below :		
	DIN : 4024 Machine foundations; Flexible supporting structures for machine with rotating masses.		
	DIN : 2089 Helical compression springs out of round wire and rod : calculation & design.		
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	DIN : 2096	Helical compression springs out of round wire and rod; quality requirements for hot formed compression springs.		
	VDI : 2056	Criteria for assessing mechanical vibrations of machine.		
	VDI : 2060	Criteria for assessing the state of balance of rotating rigid bodies.		
4.03.00	Material (Design & Supply)			
4.03.01	Steel helical springs and viscous dampers shall consist of:			
	(a)	Steel helical spring units and viscous dampers along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads, etc.		
	(b)	Frames for pre-stressing of spring elements.		
	(c)	Suitable hydraulic jack system including electric pumps, high-pressure tubes etc. required for the erection, alignment etc., of the spring units. One set of extra hydraulic jacks, and hand operated pumps shall also be provided.		
	(d)	Any other items which may be required for the pre-stressing, erection, release of pre-stress, alignment, and commissioning of the steel helical springs.		
4.03.02	The design of the supporting arrangement for the equipment supported on steel helical springs and viscous dampers shall be done by owner. The supporting arrangement shall consist of an RCC deck supported on steel helical spring units and viscous dampers which in turn shall be supported on RCC substructure. The RCC deck shall be provided by the Owner.			
4.03.03	The spring units should have stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 50% of vertical stiffness. The stiffness should be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is not more than 3 Hz.			
4.03.04	The damper units or spring-cum-damper units should be of viscous type offering velocity proportional damping. The damper units should be suitable for temperatures ranging from 0 to 50°C. The damping resistance of individual damper units should be such that the designed damping can be provided using reasonable number of Units. Damper Units shall have damping resistance ranging from 40 KN Sec / M to 300 KN Sec / M.			
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4.03.05	The sizes of the spring units, damper units and spring-cum-damper units should be such that groups of such units can be accommodated on column heads in case of elevated foundations and on pedestals / walls in case of foundations at ground level.	
4.03.06	The steel helical springs and viscous dampers shall be designed for a minimum operating life of 30 years.	
4.04.00	Manufacturing & Testing	
4.04.01	Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the approved sub vendor / supplier. For this purpose the contractor / sub vendor shall submit the detailed programme for approval of employer and take up the manufacturing / testing after approval of such programme. The programme shall include (a) Manufacturing schedule and quality check exercised during manufacturing. (b) Detail of test to be carried out at the manufacturing shop with their schedule. (c) Special requirements, if any, regarding concreting of top deck. (d) Complete step-by-step procedure covering the installation and commissioning of the spring system. (e) Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers. (f) A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers. (g) Checklist for equipment required at each stage of erection. (h) Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply. (i) Bill of material (data sheet) for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc., with their rating and numbers. (j) Any other details which may be necessary to facilitate design and construction of the foundations / structures.	
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4.04.02	The Springs shall conform to codes DIN 2089 and DIN 2096. The quality assurance and inspection procedure shall be finalised on the basis of the above codes and the quality plans be drawn accordingly.
4.05.00	Transportation
4.05.01	Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.
4.05.02	The contractor shall be responsible for any loss or damage during transportation, handling and storage.
4.06.00	Erection and Commissioning
4.06.01	Complete erection and commissioning of the steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. all by a specialist supervisor.
4.06.02	The scope of work shall be deemed to include all activities, which may not have been explicitly mentioned but are reasonably implied for the successful commissioning of steel helical springs and viscous dampers.
4.06.03	The contractor shall guarantee the performance of the steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as "Guarantee Period".
4.07.00	Supervision The supervision of installation of steel helical springs and viscous dampers including pre-stressing, placing, releasing and alignment of spring units shall be done by a specialist supervisor of sub vendor / supplier, trained for this purpose.
4.08.00	Realignment of Spring System If any realignment of the steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the contractor.
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4.09.00	Acceptance Criteria Stiffness values shall be checked. The permissible deviations shall be as per DIN 2096. Following acceptance criteria shall be followed: a) General workmanship is being good and as recommended by the manufacturer and approved by the Engineer. b) Tolerances are within the specified limit. c) Material test certificate (MTC) is in compliance with the applicable codes/standards. d) Bought out material is from the approved manufacturer / vendor. e) Bought out material is matching with the approved sample.	
5.00.00	MISCELLANEOUS REQUIREMENTS	
5.01.00	Corrosion Protection	
5.01.01	General (a) All equipments, pipes, etc. shall be painted as per the requirements specified in the relevant section of the specification. (b) All Steel structures (except those embedded in Concrete) shall be provided with Painting as given below which is designed for a minimum maintenance free life of Ten (10) years (expected life, long range Ten (10) to Twenty (20) years, as per BS : 5493. (c) All Paints shall be of high build constitution. (d) All Painting shall be done as per approved Painting scheme of the Vendors / Manufacturers, which shall be submitted by the Bidder and as approved by the Employer. Painting scheme shall also include Item codification / Description of all Coats of Paints for manufacturer's, from whom the Paint is intended to be procured.	
5.01.02	Painting of Steel Surfaces embedded in Concrete. (a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of	
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5.01.03	Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). (b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.	
	Painting of Steel Surfaces (other than those embedded in Concrete) (a) All Steel surfaces shall be provided with self curing Inorganic Zinc Silicate Primer Coat (Solid by Volume Minimum 60%) of Minimum 75 Micron Dry Film Thickness (DFT) applied over blast cleaned surface to near white metal conforming to Sa 2 ½ finish of Swedish standard SIS-05-5900. The Primer Coat shall be applied in Shop immediately after blast cleaning by Airless spray technique. (b.) Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Titanium Dioxide (TiO₂) or Micaceous Iron Oxide (MIO) Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied in Shop after an interval of Minimum overnight (from the application of Primer Coat) by Airless spray technique. (c) Intermediate Coat shall be followed with the application of Finish Coat of Polyamide Cured colour pigmented Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied after an interval of Minimum overnight and maximum indefinite (from the application of Intermediate Coat) either before Erection by Airless spray technique or after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer. The Finish Coat thickness of 75 Micron can be built up either in Single application at Shop or in two applications one at Shop and the other at Site. (d) Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 40%) of Minimum 25 Micron DFT. This Coat shall be applied within Seven (7) days (from the completion of Finish Coat), after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer.	
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5.01.04	Touch-up Painting on damaged areas (a) For Coatings damaged up to metal surface Surface preparation shall be carried out by Manual Cleaning. Minimum 6 inches adjoining area with existing Coating shall be roughened by Wire brushing, emery paper rubbing etc., for best adhesion of patch Primer. Primer Coat of self-priming Epoxy Touch-up Primer applied by brush immediately after the surface preparation. (Minimum DFT 100 Microns). Over this Primer Coat, Intermediate Coat, Finish Coat and Final Finish Coat shall be applied as covered above by brush with Intermediate Coat applied within maximum seven (7) days of application of touch up Primer. (b) For Coatings damaged upto Intermediate Coatings (i.e. where Primer Coat is intact). Damaged area including Minimum 6 inches adjoining area with existing Coating should be roughened by wire brushing, emery paper rubbing etc., for best adhesion of patch Primer without damaging the Primer Coat. Touch-up Primer, Intermediate, Finish and Final Finish Coats shall be applied as specified above for Coatings damaged up to metal surface.	
5.01.05	Painting of Welded areas / Painting of areas exposed after removal of temporary supports / Touch-up Painting on damaged areas of Employer's Structures, where inter-connection, Welding / modification etc. has been carried out by the Contractor. (a) Clean the surface to remove flux spatters and loose rust, loose Coatings in the adjoining areas of Weld seams by wire brush and emery paper. (b) Painting procedure to be followed as mentioned above for Touch-up Painting on damaged areas.	
5.01.06	Dry film thickness of each coat shall be checked and measured as per the procedure specified in paint application standard no. 2 by SSPC: The Society for Protective Coating. The thickness as measured shall not be less than the minimum thickness specified for the coat of paint under relevant clauses of technical specification.	
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5.01.07	Coating for Mild Steel parts in contact with Water. (a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS : 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS : 2629. (b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS : 3416, unless otherwise specified.	
5.01.08	Gratings All gratings shall be blast cleaned to Sa 2 ½ finish of Swedish standard SIS-05-5900 and shall be hot dip galvanised at the rate of 610 Gms / Sq. M.	
5.01.09	Hand Railings and Ladders All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS : 4736.	
5.01.10	Sea Worthiness All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.	
5.02.00	Hand Railing	
5.02.01	Minimum 1000 mm high hand railing shall be provided around all Openings, projections / balconies, walkways, platforms, Steel Stairs, etc., All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class).	
5.02.02	Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 mm high and 6 mm thick).	
5.03.00	GRATING	
5.03.01	All gratings shall be Electro-forged type. Minimum thickness of the grating shall be 40 mm for in door installation and 32 mm for outdoor installation.	
5.03.02	The Opening size shall not be more than 30 mm X 100 mm. The Minimum thickness of the main bearing bar shall be 5 mm.	
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5.03.03	Cutting of gratings shall not be carried out at Site. Any cutting of gratings required to provide passage for Columns / Pipes / Cables / Ducts etc shall be done by the Contractor in Shop and cut edges of Grating shall be suitably reinforced with binding strips.	
5.04.00	FIRE EXITS	
5.04.01	All fire exits shall be Painted with P O Red / signal Red colour shade, which shall not be used anywhere except to indicate the emergency or safety measures. Fire safety norms shall be followed as per National Building Code and requirements of various statutory bodies shall be followed for providing Fire Exits, Escape Stairs and Fire Fighting Equipment.	
5.05.00	OPENINGS	
5.05.01	Details / Data of all Openings required by the Contractor in Floors / Walls / Cladding / Roof to be provided by the Employer shall be given by the Contractor, who shall also furnish all Foundation Loads to be considered by the Employer for the Design of Foundations to support the Contractor's Structures / Equipment. Accordingly, the same shall be listed in Engineering Information Flow Schedule to be furnished by the Contractor.	
5.05.02	If the details / data of all Openings required by the Contractor in Floors / Walls / Cladding / Roof are not furnished by the Contractor, as per the Engineering Information Flow Schedule then all such required Openings shall be created by the Contractor himself, at a later date in Floors / Walls / Cladding / Roof by using special tools, as required. In this case edge protection to the Openings shall also be provided by the Contractor using Anchor Fasteners.	
5.05.03	For routing of Pipes / Cables / Ducts, Employer shall only provide suitable passage / Opening in Floors / Walls / Cladding. Any Pipe sleeves or embedments required by the Contractor in these passages / Openings shall be provided by the Contractor himself. These passage / Openings shall be suitably sealed by the Contractor after completion of Erection works.	
5.06.00	GROUTING	
5.06.01	Non-shrink cementitious flowable grout shall be used for Grouting of pockets and under-pinning work below Base Plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing Strength of the grout shall generally be one grade higher than that of the base Concrete. Minimum grade of grout shall be M30.	
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5.06.02	However, for Equipment Foundations, high Strength (Minimum Characteristic Compressive Strength of 60 N / mm ² at 28 days) ready mixed non-shrink, Chloride free, Cement based, free flowing, non-metallic grout as recommended by Equipment manufacturer shall be used. The ready mix grout shall be of reputed make as approved by the Employer.
5.06.03	The surface to be grouted shall be properly cleaned by using compressed air. Contractor shall provide the required shim plates.
5.06.04	The top surface of Foundation as constructed by the Employer may vary by + 25 mm. The same shall be suitably corrected by the Bidder by chipping before the Erection of his Structures / Equipment or subsequently during Grouting / Under Pinning, as the case may be.
5.07.00	ROOFING / CLADDING / DECKING SHEETS
5.07.01	Galvanised / Zinc Aluminium alloy coated Sheet having Trough Profile and permanently colour Coated shall be used for Roofing / Cladding / Decking.
5.07.02	Minimum bare metal thickness of Decking Sheet shall be 0.8 mm. These sheets shall be either galvanised at a Minimum rate of 275 Gm / Sq. M. or Coated with Zinc Aluminium alloy (Zincalume) at a Minimum rate of 150 Gm./ Sq. M. Silicon modified polyester Paint having DFT of Minimum 20 Microns or Super Polyester Paint having Minimum DFT of 25 Microns shall be used for permanent Coating on exposed surfaces.
5.07.03	Single Skin Sheeting for Side Cladding / Roofing / Canopy shall have Minimum base metal thickness of 0.5 mm for High Tensile Steel (having Minimum Yield Strength 550 MPa) Coated with Zinc Aluminium alloy (45 % Zn : 55% Al) at the rate of 150 Gms/ Sq. M. (Minimum) or Minimum bare metal thickness of 0.6 mm for galvanised Mild Steel Sheets (as per IS : 513) of grade 275 (Minimum) (as per IS : 277). The Sheets shall be finished with Silicon modified Paint (SMP) of Minimum 20 Microns (DFT) on external face and 7 Microns Coating on internal face. Alternately, Sheets can also be finished with Super Polyester quality Paint having total Coating thickness of 35 Microns, comprising of 20 Microns Coating on external face and 5 Microns on inner face over 5 Microns Primer Coat on both faces.
5.07.04	Moment of Inertia of Sheet, Section Modulus of Sheet, thickness of Sheet and spacing of runners / Purlin shall be compatible to satisfy the specified Deflection criteria.
5.07.05	The Sheets shall meet the general requirement of IS : 14246 and shall conform to class 3 for the durability.
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5.07.06	Z spacers if required shall be made out of at least 2 mm thick galvanised Steel Sheet of grade 275 as per IS : 277.
5.07.07	The Sheets shall be fixed by means of Stainless Steel / High performance Steel, fasteners of self-tapping / self drilling type provided with neoprene cap and washer of matching colour. Fasteners shall pass Salt Spray test for 1000 hours (Minimum).
5.07.08	The Insulation shall be bonded mineral wool conforming to IS : 8183, having a density of 32 Kg / Cu. M. for glass wool or 48 Kg / Cu. M. for rock wool.
5.07.09	All flashing, trim closures, caps etc. required for the metal Cladding System shall be made out of plain Sheets having same Material and Coating Specification as mentioned above for the Single Skin Sheets.
5.07.10	Overlap shall be as specified by the manufacturer.
5.07.11	Steam Generator Roof (Penthouse) / Canopy / Side Cladding shall have Single Skin troughed profile permanently colour coated sheets.
5.07.12	Cladding for Boiler Elevator enclosure except its Machine Room shall be with Single Skin troughed profile permanently colour coated sheets.
5.07.13	ESP Roof (Penthouse) / Canopy / Side Cladding shall have Single Skin troughed profile permanently colour coated sheets.
5.08.00	MACHINE ROOM
5.08.01	Floor / Roof of the machine room shall be of reinforced cement concrete supported on structural steel beams. The side walls shall be of brick work. Civil works including RCC floors, roof slab, door and windows (excluding trap door) flooring etc. shall be in the Employer's scope. However the structural steel members e.g. floor/roof beams, wall beams, etc. shall be supplied and erected by the Contractor.
5.09.00	NUTS AND BOLTS
5.09.01	M. S. Nuts and Bolts shall conform to IS:1363, IS:1364, IS:1367.
5.09.02	High Tensile fixing with Bolts and nuts shall respectively be as per IS:3757 and IS:6623.
5.09.03	Washers shall conform to IS 5369, IS : 5370, IS : 5372, IS 5374, IS : 6610, IS : 6649, as appropriate.
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6.00.00	STATUTORY REQUIREMENTS
6.01.00	Contractor shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules, Water Act for pollution control, Explosives Acts, etc.
6.02.00	Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include railing, fire escape, etc.
6.03.00	Provisions for Fireproof Doors, number of Staircases, etc. shall be made according to the requirements of Statutory Bodies.
6.04.00	Statutory clearances and norms of State Pollution Control Board shall be followed.
7.00.00	PERMISSIBLE TOLERANCES
7.01.00	All Structural Steel work shall be Shop fabricated outside the Plant area.
7.01.01	Tolerances on dimensions for fabrication of Steel Structures shall be according to IS : 7215.
7.01.02	Tolerances on dimensions for Erection of Steel Structures shall be according to IS : 12843.
7.01.03	Tests on Welds shall be as per ASTM standards, IS : 816 and IS : 9595.
7.01.04	Dimensional and weight tolerance of Rolled Steel shapes shall be as per IS : 1852.
8.00.00	LIST OF CODES AND STANDARDS
8.01.00	All applicable standards, references, Specifications, Codes of practice, etc., shall be the latest edition including all applicable official amendments and revisions. A complete set of all these documents shall be available at Site with Contractor.
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	ANNEXURE-WL BONGAIGAON PROJECT CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure - B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than "5" and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875 (Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a)</td><td>Welded steel structures</td><td>:</td><td>1.0%</td></tr><tr><td>b)</td><td>Bolted steel structures</td><td>:</td><td>2.0%</td></tr><tr><td>c)</td><td>Reinforced concrete structures</td><td>:</td><td>1.6%</td></tr><tr><td>d)</td><td>Steel stacks</td><td>:</td><td>As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table>			a)	Welded steel structures	:	1.0%	b)	Bolted steel structures	:	2.0%	c)	Reinforced concrete structures	:	1.6%	d)	Steel stacks	:	As per IS:6533 & CICIND Model Code whichever is more critical.	
a)	Welded steel structures	:	1.0%																	
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	ANNEXURE-B SITE SPECIFIC DESIGN PARAMETERS The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed "Vb" at ten metres above the mean ground level : 55 metres/second b) The risk coefficient "K1" : 1.08 c) Category of terrain : Category-2 Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/Sq. metre for all classes of structures, i.e. A, B & C, as defined in IS: 875 (Part-3).			
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
1.00.00	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
1.01.00	GENERAL			
1.01.01	The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.			
1.01.02	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.			
1.01.03	The Contractor upon completion of installation of equipments and systems, shall conduct precommissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All precommissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.			
2.00.00	TESTING / COMMISSIONING SCHEDULE The Contractor shall submit to the Employer, his testing/ commissioning schedules for various equipments/ systems covered under the contract, for approval, at least 18 months before the actual commissioning of the equipment/ systems. The testing/ commissioning schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of documents and commissioning checks to be submitted and their content details shall be agreed upon during preaward discussions. The list of model commissioning documents viz. standard checklists, testing/ commissioning schedules and the details regarding contents of testing/ commissioning schedule are enclosed as annexures I to IV at the end of this sub-section-VI, Part-B. These schedules are indicative only.			
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	(a.) Annexure-I : Testing Schedules & Commissioning Schedules. (b.) Annexure-II : Standard Checklist of Items. (c.) Annexure-III : List of Commissioning & Test Procedures/ Schedule to be approved by the Employer. (d.) Annexure-IV : Brief write-up on Contents of Testing Schedule.			
3.00.00	PRECOMMISSIONING ACTIVITIES			
3.01.01	GENERAL The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
3.01.02	Steam Generator (a.) Hydraulic Testing of Pressure Parts On completion of installation of the Steam Generator pressure parts, and the high pressure external piping a hydraulic test in accordance with the requirements of the Indian Boiler Regulations, shall be performed by the Contractor. The procedure adopted for hydraulic test and preservation shall have the prior approval of the Employer. The water for hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the Steam Generator and high pressure external piping shall be suitably drained and preserved. All the valves, high pressure piping and interconnected pipes connecting the pressure parts, shall be subjected to hydraulic test along with the pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves and pipings shall be furnished by the Contractor. The pressurisation equipments including water piping from the supply, and any chemicals for preservation, needed for the above test shall also be furnished by the Contractor. Any defect noticed during the testing shall be rectified and the unit shall be retested by the Contractor. The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the Project Manager.			
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	(b.) Air & Gas Tightness Test After completion of installation of furnace tubes and/or inner skin casing wherever applicable ducts and airheaters, and before commencement of application of thermal insulation a test shall be performed on the Steam Generator, ESP and FGD by the contractor to prove or to establish the tightness of the erected equipments from the outlet of FD fan through Steam Generator to the stack. Such test shall be done, as far as possible, with all mountings like soot blowers etc. installed in position. The procedure adopted for such tests shall have the prior approval of the Employer. Normally the test shall be conducted by the Contractor using fog/smoke generator. Any defects noticed during such air and gas tightness test shall be corrected and the unit retested. All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. (c.) Chemical Cleaning of Pressure Parts The Contractor shall perform thorough and efficient cleaning operations of all the internal parts of the boiler, like economiser, water wall / evaporator, separator, feedwater line, piping, start-up recirculation lines and associated piping and all other pressure parts and associated high pressure piping covered under these specifications (except those portions which are to be steam blown). The cleaning operation shall consist of De-mineralised (DM) water flushing, the chemical cleaning using acids like hydrofluoric acid or as recommended by the manufacturer, DM water rinsing, DM water flushing, nitrogen capping etc. Complete chemical cleaning procedure, the scheme and layout including parameters of the pumps, size of tanks, materials of construction, the rate of consumption and total requirements of steam and water for such cleaning process shall meet the approval of the Employer. The Contractor shall furnish all labour, materials such as the required chemicals and other consumables, all equipment such as acid transfer and acid circulating pumps complete with drive motors, acid storage and acid mixing tanks, all temporary piping, valves and specialities and local instruments for pressure, temperature and flow measurements and any other items needed to carry out the process. All equipment required for chemical cleaning of Steam Generator shall be supplied by the contractor. The Employer will arrange to supply Raw water and Demineralised water required for the cleaning operations at the Terminal Point's as indicated elsewhere, in the specification. The Contractor shall take care to dispose off the used chemicals and the effluents from the cleaning operations, after neutralisation, meeting all the statutory regulations and in a manner acceptable to the Project Manager			
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	and which would comply with the norms of the State Pollution Control Board. This include construction of suitable neutralization pit, channels, disposal equipments etc. The Contractor shall specifically make all necessary arrangements for prevention of any fire accidents, explosions etc. during the performance of the chemical cleaning operations. The Contractor shall ensure that during the cleaning process the procedure adopted shall be such as to consume minimum demineralized water. The cleaning procedure shall include final flushing and draining of the boiler under a nitrogen gas cap and/or filling the boiler with inhibited water or any other proven procedure recommended by the manufacturer for the preservation of the boiler which is acceptable to the Employer. The Contractor shall furnish a detailed procedure for boiler preservation during detailed engineering for Employer's approval. All equipment needed for such preservation including the nitrogen cylinders, interconnecting piping and any regulating equipment for N2 cap and other preservatives shall be provided by the Contractor for the steam generator and the same shall also become the property of the Employer after completion of the chemical cleaning. The Contractor shall provide adequate safety and protective equipment for all his employees and ensure that they are worn at all times of danger. Specialised treatment equipment (such as required for first aid when using hydrofluoric acid) for once through steam generators must be provided at the place of handling acid. An acid cleaning report and log of each cleaning must be provided by the Contractor to the Employer, immediately after the cleaning operation. (d.) Steam Blowing Steam blowing of complete Superheaters, Reheaters and various external pipelines shall be carried out by the Contractor as per requirements/scope of work (indicated in Part-A, Section-VI) of this specification. In addition if any other piping, not specifically mentioned in the scope of the Contractor and is also required to be steam blown, the Contractor shall extend all cooperation for steam blowing of these additional piping during steam blowing operation. The Contractor shall give recommended procedures, method of blowing and scheme for steam blowing indicating clearly additional system, if any, to be cleaned by steam blowing and furnish data/ write-up/ layouts/ drawings to that effect to the Employer for the Employer's approval. The Contractor shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for		
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	steam blowing, which in any case shall meet the steam turbine-generator requirements. The systems which should be ready and operational before steam blowing and are in the scope of the Contractor shall be made ready/operational by the Contractor by the scheduled date for starting of steam blowing. For equipments/components installed on high pressure external piping, such as various thermowells, flow meter, control valves, HP/LP Bypass valves etc., the Contractor shall comply with guidelines to be followed during steam blowing, with respect to removal / blanking / replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor. Supply of all such spools (as above) and/or blanks, temporary piping and supports etc. as required, cutting / welding / edge preparation and rewelding required for blanking, temporary piping connection and/or for replacements by spool pieces shall be the responsibility of the Contractor. After steam blowing removal of spool pieces & temporary piping and reinstallation of various components, shall also be the responsibility of the Contractor. It will be the responsibility of the Contractor to operate the Steam Generator and its accessories equipment to generate adequate steam at the parameter and quality in line with the requirements of steam blowing procedure. The Contractor shall make adequate provisions for temporary enhancement of fuel oil firing capacity of the steam generators by changing oil gun tips etc. as may be required so as to be able to conduct complete steam blowing operation by oil firing alone. All necessary precautions to avoid fires and cold end corrosion of Air preheater, during such oil firing at enhanced SG loads, shall be taken by the Contractor. The Contractor shall ensure successful and timely completion of steam blowing of all systems and will render all help/services as required including: (e) Services of test/operating personnel/supervisors. (f.) Extending all cooperation during erection, pre-commissioning of plant and equipment to be made ready and operational before starting steam blowing. (g.) Extending all cooperation for interface engineering of equipments/ components of temporary system required for steam blowing operation. (h) Contractor's engineers shall be available for all coordination meetings arranged by the Employer for finalising the details of temporary system for steam blowing. For the steam blowing operation, steam conditions like pressure, temperature etc. at the Steam Generator outlet shall be so selected that a minimum cleaning ratio/ disturbance factor of 1.6 is achieved. A cycle of			
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4.00.00 5.00.00 6.00.00 6.01.00 6.02.00	heating, cooling and blowing/ purging, is to be repeated to ensure thorough cleaning of the interior of the pipes/ tubes etc. The final indication of cleanliness shall be demonstrated by purging through target plates positioned at the discharge point. (i) Balancing of Coal/Primary air flow Contractor shall balance the primary air as well as coal flows in the pulverised fuel pipes such that the minimum PF and PA flow imbalance in the PF pipes from each coal pulveriser does not exceed 5% of average flows. The above balancing shall be checked by the Contractor by carrying out both clean air test and dirty air test (using dirty pitot tubes). Any other precommissioning activity such as floating of safety valves etc. as considered essential for readiness of facilities for commencement of commissioning activities shall also be undertaken by the Contractor (Refer Annexure-I, II & III). GAS DISTRIBUTION TEST OF ESPS BALANCE OF PLANT EQUIPMENT & SYSTEMS All pre-commissioning tests & activities as indicated in Annexure-I, II & III and elsewhere in the technical specification shall be performed by the Contractor. COMMISSIONING OF FACILITIES GENERAL Upon completion of precommissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities. Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence. The Commissioning tests/checks shall specifically include but will not be limited to following : (a.) Checks on the operation of all controls of isolating gas and air dampers.			
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7.00.00	(b.) Checks on operation of all fans to ascertain level of noise and vibration. (c.) Test running of all pumps. (d.) Checks on operation of all air heaters and adjustment of seals, if necessary when each heater is upto its working temperature. (e.) Checks on operation of all soot blowers and retraction gear and the sequences control. (f.) Check run on the Pulverised Fuel (P.F.) Mills including clean air flow test. (g.) Standard commissioning tests and procedures as per Contractor's practice for Steam Generator, Electrostatic Precipitator and other equipment / auxiliaries within the Contractor's scope of work. (h.) Checks on operation of all individual control loops in the Steam Generator control loops in the Steam Generator control system. (i.) Checks on inter-relation between each control loop in the Steam Generator control system. Checks on inter-relation between each control loop in the turbine generator control system. (j.) Checks on correct functioning of the Burner Management System (BMS). (k.) Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications. (l.) Tests on Control & Instrumentation (C&I) Equipments : The Contractor shall finalise the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer. The Contractor shall furnish requisite no. of copies of procedures and list of start up, precommissioning, commissioning and initial operation tests for Employer's approval. The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be. Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications. INITIAL OPERATION Upon completion of system checking/tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.			
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8.00.00 COLD AIR VELOCITY TEST (CAVT) The Contractor shall conduct a cold air velocity test as per Technical Specification Section-VI, Part-A, Sub-section-V. 9.00.00 THERMAL PERFORMANCE TEST (TPT) 9.01.00 During commissioning, the Contractor shall conduct a comprehensive TPT to demonstrate the Furnace Exit Gas Temperature (FEGT) and various flue gas Multishield High Velocity Temperature (MHVT) values as per relevant clauses of Sub-section-VI, Part-A, Section-VI. A detailed TPT report giving data collected/computed for the test coal as well as the computed data for the design/worst coals, using test data shall be submitted by the Contractor prior to 'Completion' of Commissioning for Employer's approval. 9.02.00 The Contractor shall conduct the comprehensive guarantee tests on the Steam Generator in co-ordination with the Steam Generator to establish the functional guarantee values at stipulated conditions as per Sub-section-VI, Part-A, Section-VI. 9.03.00 The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI). 10.00.00 COMMISSIONING SPARES 10.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commission-ing spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer. 10.02.00 These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.				
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	ANNEXURE-I			
	TESTING AND COMMISSIONING SCHEDULES			
	TESTING SCHEDULE			
	(I) MECHANICAL SYSTEMS			
	SL. NO.	DESCRIPTION		
	(a.)	ID FAN & ITS LUB OIL SYSTEM		
	(b.)	FD FAN & ITS LUB OIL SYSTEM		
	(c.)	PA FAN & ITS LUB OIL SYSTEM		
	(d.)	AIR HEATER		
	(e.)	SEAL AIR FAN		
	(f.)	SCANNER AIR FAN		
	(g.)	HEAVY FUEL OIL BURNER		
	(h.)	COAL FEEDER		
	(i.)	COAL MILL		
	(j.)	SOOT BLOWER SYSTEM		
	(k.)	SOOT BLOWER SEQUENCE		
	(l.)	AUX. STEAM SYSTEM		
	(m.)	MILL REJECT HANDLING SYSTEM		
	(n.)	STEAM GENERATOR WATER CIRCULATION PUMP (IF APPLICABLE)		
	(o.)	HFO DRAIN OIL SYSTEM		
	(p.)	HFO PRESSURE LINES		
	(q.)	HFO PRESSURISING PUMPS		
	(r.)	LDO PUMPING SYSTEM		
	(s.)	H.P. CHEMICAL DOSING SYSTEM		
	(t.)	EQUIPMENT COOLING WATER SYSTEM		
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	SL. NO. DESCRIPTION (II) ELECTRICAL SYSTEM (LT SWITCHGEAR AND MISC.) (a.) TESTING SCHEDULE FOR VARIOUS LT MCCs, LT SWITCHGEARS AND AUXILIARY CONTROL PANELS (b.) TESTING SCHEDULE FOR VFD AND ITS CONTROL PANEL (c.) TESTING SCHEDULE FOR ESP TR SETS AND EPMS (III) CONTROL & INSTRUMENTATION (a.) SG-C&I CONSISTING OF (1.) BMS (2.) S.A.D.C. (3.) AUX. PRDS (4.) OTHER (b.) OTHER SG RELATED C&I SYSTEM (c.) INSTRUMENT AND CONTROL CABLING (d.) UPS & DC POWER SUPPLY SYSTEM (e.) OTHERS C&I SYSTEMS COMMISSIONING SCHEDULES FOR FOLLOWING SYSTEMS : (a.) BOILER COMMISSIONING (b.) MILLING SYSTEM (c.) BOILER AIR AND GAS SYSTEM-INTERLOCK OPERATION (d.) SOOT BLOWER OPERATION WITH STEAM (e.) PRDS (f.) HEAVY FUEL OIL SYSTEM (g.) BOILER CHEMICAL ANALYSIS EQUIPMENT (h.) FLOATING OF SAFETY VALVES			
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	(i.) BOILER INITIAL LIGHT UP (j.) ELECTROSTATIC PRECIPITATOR (k) FLUE GAS DESULPHURISATION SYSTEM			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	PAGE 11 OF 21	

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		ANNEXURE-II		
		STANDARD CHECKLIST		
		MECHANICAL		
		SL. NO. DESCRIPTION		
		(a.) COMMISSIONING/ TESTING ESSENTIAL PRE-REQUISITE		
		VALVES		
		(1.) MANUALLY OPERATED VALVE		
		(2.) ELECTRICALLY OPERATED VALVE		
		(3.) PNEUMATICALLY ACTUATED VALVE		
		(4.) HYDRAULICALLY ACTUATED VALVE		
		(5.) SAFETY VALVE		
		(6.) ELECTROMATIC RELIEF VALVE		
		(7.) STEAM TRAP		
		(8.) BUTTERFLY VALVE (ELECTRICALLY OPERATED)		
		(9.) BUTTERFLY VALVE (MANUALLY OPERATED)		
		(10.) BUTTERFLY VALVE (FOUR WAY - ELECTRICAL)		
		(11.) NON-RETURN VALVE (INCLUDING HYDRAULIC/PNEUMATIC QCNRVS)		
		(12.) THREE WAY CONTROL VALVE		
		(13.) RELIEF VALVE		
		(14.) DIFFERENTIAL PRESSURE REGULATING VALVE		
		(15.) FLOAT OPERATED VALVES		
		TANKS AND PRESSURE VESSELS		
		(1.) TANKS (METAL) UPTO 20 M3		
		(2.) TANKS (LARGE STORAGE)		
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	एनटीपीसी NTPC		
	SL. NO. DESCRIPTION (3.) PRESSURE VESSEL (BELOW 17 BARS) (4.) AIR RECEIVER (5.) PRESSURE VESSEL - ACCESS DOOR PUMPS (I.) PUMP - LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN) (II.) PUMP - UPTO 350 HP (260 KW) (III.) PUMP - SUMP INSTALLATION (IV.) GEAR PUMP/ SCREW PUMP PIPE WORK SYSTEM (I.) STEAM SERVICES (II.) WATER SERVICES (III.) OIL/ FIRE RESISTANT FLUID SYSTEM (IV.) AIR SERVICES (COMPRESSOR) (V.) HIGH PRESSURE SERVICES (VI.) CONSTANT LOAD SUPPORT (VII.) SPRING SUPPORTS (VIII.) PF COAL (IX.) HANGERS AND OTHER SUPPORTS STRAINER AND FILTER (I.) STRAINER/ FILTER BASKET TYPE (II.) STRAINER ROTARY (LOW PRESSURE) (III.) FILTER & STRAINERS CENTRIFUGAL SEPARATORS (IV.) FILTER & STRAINER Y-TYPE (V.) FILTER & STRAINER (PLATE TYPE)			
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	SL. NO.	DESCRIPTION		
		(VI.) PURIFIER		
		(VII.) FILTER - COMPRESSED AIR LINE		
		HEAT EXCHANGER		
		(I.) HEAT EXCHANGER (GENERAL)		
		(II.) HEAT EXCHANGER - OIL/ WATER		
		(III.) ROTARY AIR HEATER		
		FANS & COMPRESSORS		
		(I.) FANS - NON-PRESSURE LUBRICATED		
		(II.) FANS - AXIAL FLOW PRESSURE LUBRICATED		
		(III.) COMPRESSORS - GENERAL		
		DAMPERS & GATES		
		(I.) MANUALLY OPERATED DAMPER		
		(II.) PNEUMATICALLY OPERATED DAMPER		
		(III.) ELECTRICALLY OPERATED DAMPER		
		(IV.) MANUALLY OPERATED GATES		
		(V.) PNEUMATICALLY OPERATED GATE		
		(VI.) ELECTRICALLY OPERATED GATE		
		DUCT WORK		
		(I.) BOILER FLUE DUCTING		
		(II.) EXPANSION JOINTS		
		(III.) OBSERVATION & ACCESS DOOR		
		CRANES AND ELEVATORS		
		(I.) AUXILIARY OVERHEAD CRANE		
		(II.) TRAVEL SUPPORT STRUCTURE FOR CRANE		
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	SL. NO. DESCRIPTION (III.) LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE (IV.) MAIN AUX. HOIST MOTION (CRANE) (V.) CRANE, ELECTRIC HOIST POWER TRANSMISSION (I.) POWER TRANSMISSION GEAR BOX (II.) Bearings (III.) Fluid Couplings BOILER & AUX. SYSTEM (I.) SOOT BLOWER LONG RETRACTABLE (II.) WALL DESLAGGER/ SOOT BLOWER (III.) BOTTOM ASH HOPPER (IV.) FLY ASH HOPPER (V.) LUBRICATOR - COMPRESSED AIR LINES (VI.) WIND BOX ASSEMBLY (VII.) MIXER/ STIRRER (VIII.) COMPRESSED AIR BREATHING APPARATUS (IX.) OIL BURNER (X.) OIL BURNER END REGISTER (XI.) IGNITORS (XII.) SCANNER (XIII.) MANUAL LUBRICATORS (XIV.) AIR MOTOR (XV.) DRIERS - NON REGENERATIVE / REGENERATIVE (XVI.) COAL BUNKER			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	PAGE 15 OF 21

CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	एनटीपीसी NTPC		
	SL. NO. DESCRIPTION ELECTRICAL (I.) D.C. MOTOR (II.) HV SQUIRREL CAGE INDUCTION MOTOR (III.) 415 V SQUIRREL CAGE INDUCTION MOTOR (IV.) MOTOR OPERATED ACTUATORS (V.) SOOT BLOWER (DESLAGER) (VI.) SOOT BLOWER (LONG RETRACTABLE) (VII.) SOOT BLOWER (AIR HEATER) (VIII.) LT SWITCHGEAR/MCC (1.) SWITCHGEAR ROOM (2.) STANDARD CHECKLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM (3.) PT CARRIAGE AND CUBICLE (4.) CABLE/BUS DUCT / BUS BARS (5.) CONTACTOR MODULE (6.) SWITCH FUSE MODULE (7.) MASTER PANEL OF LUBE OIL PANEL (8.) FEEDER PANEL OF LUBE OIL PANEL (9.) SPACE HEATER AND CABLE MODULE (10.) 415 V AIR CIRCUIT BREAKER (IX.) POWER CABLE (X.) AUXILIARY CABLE (XI.) D.C. CABLE (XII.) EXPLOSION PROOF ELECTRICAL EQUIPMENT			
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	SL. NO. DESCRIPTION (XIII.) JUNCTION BOX (XIV.) CONTROL TRANSFORMER MODULE (XV.) SOOT BLOWER SEQUENCE PANEL (XVI.) BRUSH GEAR ASSEMBLY (XVII.) AUX. CONTROL AND RELAY PANEL DESK (XVIII.) BRUSH GEAR (GENERATOR SLIP RING BRUSH GEAR ASSEMBLY (IF APPLICABLE) (XIX.) CHECKLIST FOR ALL TYPES OF RELAYS, MODULES AND SCHEMES OF GENERATOR EXCITATION SYSTEM (XX.) INDICATING INSTRUMENT (XXI.) RECORDING INSTRUMENT (XXII.) INTEGRATING INSTRUMENT CONTROL & INSTRUMENTATION (I.) CONDUCTIVITY MEASURING EQUIPMENT INCLUDING TEST PROCEDURES (II.) pH ANALYSER INCLUDING TEST PROCEDURE (III.) LEVEL SWITCH (FLOAT ACTUATED) (IV.) LEVEL SWITCH (ELECTRODE TYPE) (V.) LEVEL SWITCH (DISPLACED ACTUATED) (VI.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURES (VII.) LEVEL INDICATOR (FLOAT/ PULLEY TYPE) (VIII.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE (IX.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	PAGE 17 OF 21	

CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	SL. NO. DESCRIPTION (X.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE (XI.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/TRANSMITTER INCLUDING TEST PROCEDURES (XII.) TEMPERATURE SWITCH INCLUDING TEST PROCEDURES (XIII.) COLD JUNCTION BOXES (XIV.) ZENER BARRIER (XV.) O2 ANALYSER (XVI.) O2 IN HYDROGEN INCLUDING TEST PROCEDURES (XVII.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE (XVIII.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE (XIX.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE (XX.) FLOW INDICATOR (VARIABLE AREA) (XXI.) ORIFICE PLATE (XXII.) FLOW SWITCH (XXIII.) WEIR (XXIV.) NOZZLE (XXV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING (XXVI.) TEST PROCEDURE (XXVII.) FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE (XXVIII.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE			
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CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
	(XXIX.) VENTURI (FLUID) (XXX.) FLOW SWITCH (MAGNETIC TYPE) (XXXI.) AVERAGING INLET (XXXII.) LIMIT SWITCHES (XXXIII.) POSITION MEASUREMENT & INDICATION INCLUDING TEST PROCEDURES (XXXIV.) VIBRATION MEASUREMENT (XXXV.) DIGITAL INDICATOR (XXXVI.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE (XXXVII.) RECORDER INCLUDING TEST PROCEDURE (XXXVIII.) FLAME SCANNER (XXXIX.) ELECTRICAL AUTO MANUAL CONTROL STATION (XL.) PUSH BUTTON MODULE (XLI.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PROCEDURE (XLII.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS (XLIII.) THERMO CONTROL VALVE (XLIV.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER-PID TERMS (XLV.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT & (XLVI.) PNEUMATIC OUTPUT			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	PAGE 19 OF 21

CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	एनटीपीसी NTPC																							
	ANNEXURE-III PRECOMMISSIONING AND COMMISSIONING OF FACILITIES COMMISSIONING PROCEDURE/ TESTING SCHEDULE REQUIRING APPROVAL OF THE EMPLOYER FOR STEAM GENERATOR (BOILER) AND ELECTROSTATIC PRECIPITATOR <table><tr><th>SL. NO.</th><th>DESCRIPTION</th></tr><tr><td>(I.)</td><td>BOILER HYDRAULIC TEST AND PRESERVATION PROCEDURE</td></tr><tr><td>(II.)</td><td>BOILER CHEMICAL CLEANING</td></tr><tr><td>(III.)</td><td>AIR AND GAS TIGHTNESS TEST-FURNACE, DUCTS & ESP</td></tr><tr><td>(IV.)</td><td>STEAM BLOWING OF BOILER INCLUDING INTERCONNECTING PIPE LINES OF BOILER, TURBINE, AUX. STEAM HEADER AND STEAM SUPPLY LINES.</td></tr><tr><td>(V.)</td><td>STEAM BLOWING OF FUEL OIL SYSTEM</td></tr><tr><td>(VI.)</td><td>OIL FLUSHING OF FUEL OIL SYSTEM</td></tr><tr><td>(VII.)</td><td>CLEAN AIR FLOW TEST OF COAL PIPES</td></tr><tr><td>(VIII.)</td><td>OIL FLUSHING OF LUB OIL SYSTEM OF ROTATING EQUIPMENT</td></tr><tr><td>(IX.)</td><td>COLD AIR VELOCITY TEST</td></tr><tr><td>(X.)</td><td>ESP GAS DISTRIBUTION TEST</td></tr></table>	SL. NO.	DESCRIPTION	(I.)	BOILER HYDRAULIC TEST AND PRESERVATION PROCEDURE	(II.)	BOILER CHEMICAL CLEANING	(III.)	AIR AND GAS TIGHTNESS TEST-FURNACE, DUCTS & ESP	(IV.)	STEAM BLOWING OF BOILER INCLUDING INTERCONNECTING PIPE LINES OF BOILER, TURBINE, AUX. STEAM HEADER AND STEAM SUPPLY LINES.	(V.)	STEAM BLOWING OF FUEL OIL SYSTEM	(VI.)	OIL FLUSHING OF FUEL OIL SYSTEM	(VII.)	CLEAN AIR FLOW TEST OF COAL PIPES	(VIII.)	OIL FLUSHING OF LUB OIL SYSTEM OF ROTATING EQUIPMENT	(IX.)	COLD AIR VELOCITY TEST	(X.)	ESP GAS DISTRIBUTION TEST		
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BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES																						
			PAGE 20 OF 21																						

CLAUSE NO.	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES	एनडीपीसी NTPC	
	ANNEXURE-IV BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULES TESTING SCHEDULES SHOULD BE DESIGNED TO ENSURE THAT THE PLANT AREA, EQUIPMENT OR APPARATUS ARE TESTED AND COMMISSIONED AND WILL OPERATE AS PER THE EMPLOYER'S SPECIFICATIONS AND GOOD ENGINEERING PRACTICES. TESTING SCHEDULE IS REQUIRED TO BE OF A STANDARD FORMAT IN ORDER TO MAINTAIN CONSISTENCY OF PRESENTATION, CONTENT AND REPORTING THE TESTING SCHEDULES SHOULD CONTAIN THE FOLLOWING SECTIONS TO MAKE THE DOCUMENT A SELF CONTAINED ONE: (I) PLANT DETAILS/ DESIGN DATA (II) TESTING OBJECTIVE/ PROPOSALS (III) STATE OF THE PLANT (1.) ERECTION STATUS WITH RESPECT TO MECH., ELECT. AND C&I (2.) AVAILABILITY OF THE SERVICES REQUIRED (3.) SAFETY REQUIREMENTS AS PER MANUFACTURER'S (4.) RECOMMENDATIONS (IV) TEST METHOD INCLUDING COMPLETION/ ACCEPTANCE CRITERIA (V) RESULTS (VI) APPENDIX (1.) TESTING PROGRAMME (2.) MECH./ ELECT./ C&I PLANT ITEM COMPLETION LIST (3.) LIST OF DRAWINGS/ DOCUMENTS REQUIRED FOR CARRYING OUT THE TESTING		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-VI PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES
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**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR (ESP) PACKAGE
FOR BONGAIGAON THERMAL POWER PROJECT (3 X 500 MW)
BID DOCUMENT NO. CS-4610-101-2
(Experience List of Bidder/His Sub Vendor - Applicable to all the Bidders)**

We, hereby furnish the data on proveness criteria for critical equipment, auxiliaries, systems, and Bought Out Item (such as PA, ID and FD Fans, Coal Pulverizes, Raw Coal feeders, Air Preheaters, Mill Reject Handling System, ID Fan motor, Auxiliary boiler and Gas to Gas Heat Exchangers, Wet-Limestone Grinding mills, Lime stone slurry pumps for the flue Gas Desulphurisation system, Power cycle piping, C&I equipment/systems, Electrostatic Precipitator, Electrostatic Precipitator Transformer Rectifier Set, Wet-Limestone based flue Gas, Desulphurisation system) which have been manufactured and supplied by us (manufactured / sub-vendors) and these are in successful operation in atleast one (1) coal fired plant for a period not less than one (1) year on date of bid opening. The details of type and minimum equipment rating of such equipment are given below :

S. No.	Item Description	Station-I	Station-II
K.	Wet Lime stone Based Flue Gas Desulphurisation system (FGD)		
1.00.00	Name of the station and location		
1.01.00	Client name and his address		
	Fax No.		
	e-mail id		
	website address		
1.01.01	Name and Designation of the responsible person in client's organisation		
1.01.02	Name of the manufacturer & address		
1.01.03	Contract No. & Date		
1.01.04	Capacity in MW of Unit		
1.01.05	Starting date of work		
1.01.06	Scheduled date of completion		

1.01.07	Actual date of completion		
1.01.08	Date of Commissioning of FGD system/Package		
1.01.09	Whether the FGD system/equipment are in successful operation as on date of bid opening	Yes / No	Yes / No
1.01.10	Whether the FGDs operating in conjunction with pulverized coal fired steam generator. FGD flue gas treatment capacity	Yes / No	Yes / No
1.01.11	Type of FGD supplied in the reference plant		
	- Wet lime stone based system.	Yes / No	Yes / No
	- Whether Efficiency of FGD is more than 85%	Yes / No	Yes / No
	- Actual guaranteed dust Sox removal efficiency FGD	Yes / No	Yes / No
1.01.12	Scope of work executed by us for the aforesaid FGD set includes the following:		
	a) Designed	Yes / No	Yes / No
	b) Engineered	Yes / No	Yes / No
	c) Manufactured	Yes / No	Yes / No
	d) Erected*/supervised Erection	Yes / No	Yes / No
	e) Commissioned*/Supervised Commissioned*	Yes / No	Yes / No
1.01.13	Whether the we limestone based flue gas sulphurisation system has been in successful operation for a period not less than one (1) year as on date of bid opening .	Yes / No	Yes / No

S. No.	Item Description	Station-I	Station-II
L.	LIMESTONE GRINDING MILLS		
i)	Name of the station and location		
ii)	Client name and his address		
	Fax No.		
	e-mail id		
	website address		
iii)	Name of the manufacturer & address		
iv)	Date of commission of the Limestone mill		
	(a)		
	(b)		
	(c)		
v	Details of units		
	(a) Capacity in MW of Unit		
	(b) Type & No.Of Absorber tanks per unit		
	(c) No. of limestone mill for FGD per unit/all FGDs of complete station (as applicable)		
(vi)	Brief Technical particulars of the Limestone mill		
	(a) Type		

S. No.	Item Description	Station-I	Station-II
	(b) Size & Model no.		
	(c) Capacity (Tonnes/hr.) (i) Capacity of limestone mill for the reference plant (Tonnes/hr.) under following associated conditions: (bidder to fill in below) a. Limestone fineness (....% through mesh) b. Limestone input (....% upto mm) c. Bond index of Limestone fineness (....)		
	(ii) Capacity of limestone mill for the reference plant (Tonnes/hr.) under following associated conditions a. Limestone fineness 90% through 325.mesh) b. Limestone input size up to 25 min c. Bond index of Limestone (iii) Bidder to enclose all relevant correction curve for variation in the mill capacity of the reference plant w.r.t parameters indicated at (ii) above		

S. No.	Item Description	Station-I	Station-II
	(d) Details of materials for mill component for the reference plant. (i) Material & Wear Life of water parts Material - Material of liners - Material grinding balls - Wear life of liners - Consumption of grinding balls. (e) Details of limestone quality for the project 1. CaO ———% 2. bond index (.....)		
	(vii) Whether the limestone mill is in successful operation for a period not less than one (1) year as on the date of bid opening	Yes / No	Yes / No

S. No.	Item Description	Station-I	Station-II
M	GAS TO GAS HEAT EXCHANGER (GGH)		
i)	Name of the station and location		
ii)	Details of units		
	a) Capacity of each unit (MW) b) No. of Gas to Gas Heat Exchangers per unit/FGD Plant.		
iii)	Client name and his address		
	Fax No.		

	e-mail id		
	website address		
iv)	Name of the manufacturer & address		
v)	Date of commission of the GGH		
(vi)	Brief Technical particulars of the Limestone mill (a) Type (b) Model (c) Size		
	(d) Type of Medium (if any being used for application) & quantity entering GGH(T/hr.) (e) Hot Gas quantity entering GGH(T/hr.) (f) Coal Gas Quantity entering GGH(T/hr.) (g) GGH element material (h) GGH element material life		
(vii)	Whether the GGH is in successful operation for a period not less than one (1) year as on the date of bid opening	Yes / No	Yes / No
N.	LIME STONE SLURRY PUMPS		
i)	Name of the station and location		
ii)	No.of units & capacity in MW of unit		
iii)	No.of pumps per unit/FGD plant		
iv)	Client name and his address		
	Fax No.		

	e-mail id		
	website address		
v)	Name and Designation of the responsible person in client's organisation		
vi)	Name of the manufacturer & address		
vii)	Contract No. & Date		
viii)	Starting date of work		
ix)	Scheduled date of completion		
x)	Actual date of completion		
xi)	Date of Commissioning of system/Package		
xii)	Whether the system/equipment are in successful operation as on date of bid opening		
xiii)	Brief scope of work		
xiv)	Brief Technical Particulars (each type) of the - Type & Model - Capacity & Duty condition - Head		
xv)	Whether the Limestone slurry pumps is in successful operation for a period not less than 1 (one) year as on the date of bid opening	Yes / No	Yes / No

Bidder to strike off which ever is not applicable

**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR
BONGAIGAON THERMAL POWER PROJECT, (3 X 250 MW)
BID DOCUMENT NO. CS-4610-101-2
(Guarantee Declaration)**

Bidder's Name & Address :

To
Contract Services (Th-I),
NTPC Limited,
NOIDA - 201 301.

Dear sir,

We declare that the ratings, capacities and performance figures of the equipment furnished by us under the package are guaranteed. We further declare that in the event of any deficiencies in meeting the guaranteed figures indicated below as established after conducting the guarantee tests, you may at your discretion accept the equipment/system after assessing the liquidated damages as specified in Sub-Section-VI, Part-A, Section-VI (Technical Specifications) of the Bidding Documents, or reject the equipment/system and recover payments already made.

S.No.	Guaranteed Parameters	Guaranteed Figures
(i)	Steam Generator efficiency in percentage, while firing the design coal, (blended) specified in Table I (C), sub-section-V, Part-A, Section-VI at rated steam parameters rated coal fineness and rated excess air (in accordance with the requirement stipulated in clause no. 3.01.00 (i) (a) & (b) sub-section-VI, Part-A, Section-VI, Technical Specification) at the following stipulated loads :	Trichy
	(a) at 100% TMCR (250MW) unit load	%
	(b) at 80% TMCR (200MW) unit load	%

S.No.	Guaranteed Parameters	Guaranteed Figures
(ii)	Steam Generator capacity (each unit) in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working as per Employer's discretion) with the coal being fired from within the range specified in Table-1C, sub-section-V, Part-A, Section-VI of Technical Specification (clause no. 3.01.00(ii) , Sub-Section-VI, Part-A, Section-VI, of Technical Specification)	T/hr. Trichy
(iii)	Feed water pressure required at economiser inlet (at stop valve inlet) for main steam flow at 100% TMCR unit load (250 MW) (Clause no. 3.01.00 (iii) sub-section-VI, Part-A of Section-VI of Technical Specification)	kg/cm ² (abs) Trichy
(iv)	Superheater attemperation spray water flow in T/hr. in accordance with clause 3.01.00 (iv) , sub-section-VI, Part-A of Section-VI of Technical Specification, while firing design coal (blended) specified at Table-1C, sub-section-V, Part-A of Technical Specification and maintaining rated SH outlet steam temperature at	 Trichy
(a)	100% TMCR (250MW) unit load	T/hr.
(b)	80% TMCR (200MW) unit load	T/hr.

S.No.	Guaranteed Parameters	Guaranteed Figures
(v)	Minimum life of coal pulveriser wear parts in hours of operation for entire range of specified coals (in accordance with Clause 3.01.00 (v), Sub-Section VI, Part-A, Section-VI, Technical Specifications).	BHEL Hyd □
a)	Classifier vanes (hours of operation) As per clause 12.05.14 (5), Sub-section-II-M1, Part-B, Section-VI, Technical Specification	hrs
b)	Classifier cone and other items lined with ceramic material (hours of operation) As per clause 12.05.14 (4), Sub-section-II-M1, Part-B, Section-VI, Technical Specification.	hrs
c)	Mill discharge valve (hours of operation) As per clause 12.05.14 (3), Sub-section-II-M1, Part-B, Section-VI, Technical Specification.	hrs
d)	Seals (hours of operation) As per clause 12.05.14 (1), Sub-section-II-M1, Part-B, Section-VI, Technical Specification.	hrs
e)*	Grinding elements (rolls/Balls/ Tyres) (hours of operation) As per clause 12.05.14(2), Sub- Section-IIM1, Part-B, Section-VI	hours
f)*	Grinding Ring/Race/Segments (hours of operation) As per clause 12.05.14(2), Sub- Section-IIM1, Part-B, Section-VI	hours

S.No.	Guaranteed Parameters	Guaranteed Figures
	(g) All other parts coming in contact with coal (hours of operation)	hours
(vi)	Minimum sustained efficiency of Electrostatic Precipitator under guarantee point condition (in accordance with clause 3.01.00 (vi), sub-section-VI, Part-A, Section VI) at 100% TMCR (250 MW unit load) when firing design coal (blended) specified at Table-1C sub-section-V, Part-A of Tech. Spec.	% (To limit the outlet dust burden from ESP to 18 mg/Nm³ (max.)) AQCS/BAP/Rpt ☐
(vii)	SO₂ Removal efficiency of FGD system SO ₂ removal efficiency of the Flue Gas Desulphurization (FGD) system, under Guarantee Point Conditions stipulated in clauses nos. 1.02.00 of Part-B, Sub-Section M4.	% AQCS/BAP/Rpt ☐
(viii)	Limestone consumption of FGD system Limestone consumption of FGD system in kg./hr at 100% TMCR (250 MW unit load) under Guarantee Point Conditions stipulated in clauses nos. 1.02.00 of Part-B, Sub-Section M4 and So ₂ removal efficiency of not less than 95%	Kg/hr. AQCS/BAP/Rpt ☐
(ix)	Auxiliary Power Consumption The auxiliary power consumption for all the equipment & auxiliaries related to steam generator ESP, FGD equipment cooling water pumps, mill reject handling system, compressed air system etc. including all auxiliaries listed at clause no. 6.00.00, Sub-Section-	KW

S.No.	Guaranteed Parameters	Guaranteed Figures
	VI, Part-A, Section-VI. required for continuous unit operation at rated steam parameter at ambient air temperature of 27°C and 60% RH respectively and with other conditions as stipulated in clause no. 3.01.00 (ix) Sub-Section-VI, Part-A of Section-VI, Technical Specifications	ALL, as per Enclosure to Annexure-I ☐
(a)	100% TMCR (250MW) unit load	KW
(b)	80% TMCR (200MW) unit load	KW
	(Bidder to furnish the break up of the quoted auxiliary power consumption for information, as Annexure-I)	

Date : (Signature)
 Place : (Printed Name)
 (Designation)
 (Common Seal).....

Note : Any variation to the stipulated conditions under which guarantee are to be met will not be permitted and Bids with such variations are liable to be rejected.

ANNEXURE - I TO ATTACHMENT - 10A

Page 1 of 1

**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR
BONGAIGAON THERMAL POWER PROJECT, (3 X 250 MW)****BID DOCUMENT NO. CS-4610-101-2**

(Break up of Guaranteed Auxiliary Power Consumption Guarantee
Quoted as per clause (vii) of Attachment 10A of Bid Form)

Bidder's Name & Address :

To
Contract Services (Th-I),
NTPC Limited,
NOIDA - 201 301.

Dear sir,

S.No	Name of Auxiliaries	Nos. in operation	Power Consumption	
			At load 100% TMCR	At load 80% TMCR
1.				
2.				
3.		Refer Enclosure - I ☐		
4.				
5.				
6.				

Date :

(Signature)

Place :

(Printed Name)

(Designation)

(Common Seal).....

**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR
BONGAIGAON THERMAL POWER PROJECT, (3 X 250 MW)
BID DOCUMENT NO. CS-4610-101-2
(Guarantee Declaration)**

Bidder's Name & Address :

To
Contract Services (Th.-I),
NTPC Limited,
NOIDA - 201 301.

Dear sir,

We declare that performance figures of the equipments furnished under the package are guaranteed (as per clause 7.00.00 of Sub-Section-VI, Part-A, Section-VI under category-II guarantees). We further declare that in the event of any deficiency in meeting the guaranteed figures indicated below as established after conducting the guarantee test, you may reject the equipment/system/plant and recover the payments already made.

S.No.	Guaranteed Parameters	Guaranteed Figures
(i)	Maximum total NO _x (thermal as well as fuel) emission from each unit in gram per Giga Jule of heat input to the boiler for the entire operating range of Steam Generator and for the range of coal specified (in accordance with clause no. 7.01.01 of Sub-Section-VI, Part-A, Section-VI)	grams per Giga Jule of heat input (thermal as well as fuel)
		Trichy ☐

Date : (Signature)

Place : (Printed Name)

(Designation)

(Common Seal).....

**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR
BONGAIGAON THERMAL POWER PROJECT, (3 X 250 MW)
BID DOCUMENT NO. CS-4610-101-2
(Demonstration Parameters/Capabilities)**

Bidder's Name & Address :

To
Contract Services (Th.-I)),
NTPC Limited,
NOIDA - 201 301.

Dear sir,

We declare that the ratings, capacities and performance figures of the equipment/system furnished by us under this package are to be demonstrated by us. We further declare that in the event of any deficiencies in meeting the above parameters in respect of the characteristics mentioned below as established after conducting the guarantee test, you may at your discretion reject the equipment/system and recover payment already made or accept it after assessing the deficiency and effecting recovery from the contract price as specified in Sub-section-VI, Part-A, Section-VI (Technical Specification) of bidding document.

1.01.00 Steam Generator and Auxiliaries

(i)	Coal Pulveriser capacities in T/hr. with design coal at rated fineness as per clause 8.02.00 (i), Sub-Section VI, Part-A, Section VI.	BHEL/Hyd ☐
(a)	At 100% mill loading with new set of grinding elements	T/hr.
(b)	At 90% mill loading with the originally installed grinding elements in nearly worn out condition or at the end of guaranteed wear life of grinding elements (whichever is earlier)	T/hr.
(ii)	Operating life of ceramic lining of pulverised fuel pipes in hours of operation as per clause 8.02.00 (ii), Sub-Section VI, Part-A, Section VI.	BHEL/Hyd ☐ hrs.
(iii)	Minimum steam generator (% of BMCR) load above which no oil support is required as per clause 8.02.00 (iii), Sub-section-VI, Part-A, Section-VI	Trichy ☐%

(iv)	Performance characteristics of ID, PA, FD & Mill seal air Fans (capacity, head developed etc.)	 Trichy & Fans/BAP
(v)	Capabilities of All drives (Refer Clause 8.02.00 (v), Sub-Section-VI, Part-A, Section-VI)	 Trichy & Fans/BAP
(vi)	Margin on fans (Ref clause no. 8.02.00 (vi), Sub-section-VI, Part-A, Section-VI).	 Trichy & Fans/BAP
(a)	Seal Air Fans (Refer cl.12.05.06, Sub-Section-II-M1, Part-B, Section-VI)	.....
(b)	Primary Air Fans (Refer cl. 12.08.00, Sub-Section-II-M1, Part-B, Section-VI)	.....
(c)	Forced Draft fan & Induced Draft fan (Refer cl. 14.02.00, Sub-Section-II-M1, Part-B, Section-VI)	.....
(vii)	Run back capabilities (Ref. clause 8.02.00 (vii), Sub-section VI, Part-A, Section-VI)	Fans/BAP
(viii)	Demonstration of boiler operation for rate of change of load and sudden load change withstand capability with important parameter deviations within permissible limits. (Ref. clause 8.02.00 (viii) Sub-section VI, Part-A, Section-VI and clause 1.11.00, 1.14.02, Sub-Section-II-M1, Part-B, Section-VI)	Trichy

- (ix) Maximum Furnace exit gas temperature (degree celsius) (MHVT Value) in accordance with clause 8.02.00 (ix), Sub-section VI, Part-A, Section-VI. **Trichy** ☐
- (x) Cold air velocity test (CAVT) (in accordance with clause 8.02.00 (x), Sub-section-VI, Part-A, Section-VI) **Trichy** ☐
- (a) Maximum average flue gas velocity at different steam generator sections (m/Sec.)
- (b) Maximum deviation at each section with respect to average flue gas velocity (%)
- (xi) Flue Gas temperature at entry & exit of various boiler heating surfaces (Actual/MHVT Values) (In accordance with clause 8.02.00 (xi), Sub-Section VI, Part-A, Section-VI) **Trichy** ☐
- (xii) Maximum steam temperature imbalance at superheater (SH) & reheater (RH) outlets between left and right header (degree celcius) (In accordance with clause 8.02.00 (xii), Sub-Section VI, Part-A, Section-VI) **Trichy** ☐
- (xiii) Air heater air-in leakage and max. drift in Air leakage (% of gas flow at AH inlet), (In accordance with Clause No. 8.02.00 (xiii), Sub-Section-VI, Part-A, Section-VI) **APH/BAP/Rpt** ☐
- (xiv) Steam generating capacity (T/hr.) of Steam Generator when one and/or both or all strings of HP heaters are out of operation. (In accordance with clause no.8.02.00 (xiv), Sub-Section-VI, Part-A, Section-VI) **Trichy** ☐
- a) With one string of HP Heaters out

- b) With both strings of HP Heaters
out
- (xv) Maximum air in leakage in ESP as
percentage of total gas flow at
the guarantee point conditions as **AQCS/BAP/Rpt**
per clause no. 8.02.00(xvi), sub-
section-VI, Part-A, Section-VI
- (xvi) Max. ESP pressure drop at guarantee
point as per clause 8.02.00 (xvii),
Sub-Section-VI, Part-A, Section-VI **AQCS/BAP/Rpt**
- (xvii) Demonstration of Gas distribution
among various gas steams and
fields of ESP within limits specified
in IGCI publication for EP7 at the **AQCS/BAP/Rpt**
guarantee point as per Cl. No.
8.02.00 (xviii), Sub-Section-VI, Part-A,
Section-VI of Technical Specification
- (xviii) Total pressure drop in gas path of
FGD system (across the absorber &
gas-gas heater) at 100% TMCR with
boiler firing the design coal (blended) **AQCS/BAP/Rpt**
specified in Table-1(C), Sub-Section-V,
Part-A under conditions stipulated in
sub-section-M4, Part-B of Technical
Specification
- (xix) Stack inlet temperature with FGD
system in operation at 100% TMCR
with boiler firing design coal (blended)
specified in Table 1(C), sub-section-V, **AQCS/BAP/Rpt**
Part-A & under conditions stipulated
in sub-section M4, Part-B of the
Technical Specification, (Clause 8.02.00
(xxii), sub-section-VI, Part-A)

(xx)	Life of limestone mills wear parts as per clause 8.02.00 (xxiii) (i), sub-section-VI, Part-A of the Technnical Specification	 AQCS/BAP/Rpt □
(xxi)	Capacity of each limestone mill as per clause 8.02.00 (xxiii) (ii) sub-section-VI. Part-A of the Technnical Specification	 AQCS/BAP/Rpt □
(xxii)	Limestone mill ball consumption as per Clause 5.04.06 sub-section-II M4 of Part-B of the Technnical Specification	 AQCS/BAP/Rpt □
(xxiii)	Capacity of vacuum belt filters as pe clause 8.02.00 (xxiv) sub-section-VI, Part-A of the Technnical Specification	 AQCS/BAP/Rpt □
(xxiv)	Purity of gypsum filtered out of vacuum belt filters as per clause 8.02.00 (xxv), sub-section-VI, Part-A of the Technnical Specification	 AQCS/BAP/Rpt □
(xxv)	Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level as specified over the entire range of output and operating frequency specified as per 8.01.00 of Sub-section-VI of Part-A, Section-VI & Clause 14.00.00 of Part-C of Section-VI	 ALL □
(xxvi)	The demonstration parameters/capabilities of other equipments shall be as per specification requirements (Refer clause no. 8.10.00, Sub-section-VI, Part-A, Section-VI)	 ALL □

(xxvii) Power Cycle Piping

Actual hanger readings under cold and hot condition (at rated parameters) to match those of design cold and hot hanger readings for MS/CRH/HRH/ HP & LP bypass piping system as per clause 8.03.00, sub-section-VI, Part-A, Section-VI

.....
PC/Chennai ☐**(xxviii)** Demonstration of over load test, travel and hoisted speed for passenger & good elevator in accordance with clause no. 8.04.00, Sub-section-VI, Part-A, Section-VI.....
Trichy & PEM ☐**(xxix)** Rated capacity (T/hr.) of mill rejects system in accordance with clause no. 8.05.00, Sub-section-VI, Part-A, Section-VI.....
PEM ☐**(xxx)** Capacity & total dynamic head of all fuel oil & LDO unloading pumps as per Cl. 8.06.00, sub-section-VI, Part-A of the Technnical Specification.....
PEM ☐**(xxxix)** Equipment Cooling water system guarantees in accordance with as per clause no. 8.07.00, Sub-section-VI, Part-A, Section-VI.....
PC/Chennai ☐**(xxxix)** Air Compressors and Air drying plant guarantees in accordance with, clause 8.07.01, Sub-section-VI, Part-A, Section-VI.....
PEM ☐**(xxxix)** Electrical system guarantees in accordance with clause no. 8.08.00, Sub-section-VI, Part-A, Section-VI.....
C&I Trichy ☐**(xxxix)** Control & Instrumentation system guarantees in accordance with clause no. 8.09.00, sub-section-VI, Part-A, Section-VI.....
C&I Trichy ☐

Date : (Signature).....

Place : (Printed Name).....

(Designation)

(Common Seal).....

Note : For all other equipment included in the scope of supply of bidder but not covered above, the demonstration tests to be carried out shall be mutually finalised between Contractor & Employer.

**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR
BONGAIGAON THERMAL POWER PROJECT, (3 X 250 MW)
BID DOCUMENT NO. CS-4610-101-2
(Guarantee Declaration For Alternate Offer)**

Bidder's Name & Address :

To
Contract Services (Th.-I),
NTPC Limited,
NOIDA - 201 301.

Dear sir,

We declare that the ratings, capacities and performance figures of the equipments furnished by us under the alternative offer for the package are guaranteed. We further declare that in the event of any deficiencies in meeting the guaranteed figures indicated below as established after conducting the guarantee tests, you may at your discretion accept the equipment/system after assessing the liquidated damages as specified in Sub-Section-VI, Part-A of Technical Specifications, Section-VI or reject the equipment/system and recover payments already made.

Sl.No.	Guaranteed Parameters	Guaranteed Figures

As Applicable ☐

Date : (Signature).....

Place : (Printed Name).....

(Designation)

(Common Seal).....

Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
	A. Contract and Interpretation	
1. Definitions	1.1 The following words and expressions shall have the meanings hereby assigned to them :	
	“Contract” means the Contract Agreement entered into between the Employer and the Contractor, together with the Contract Documents referred to therein; they shall constitute the Contract and the term “the Contract” shall in all such documents be construed accordingly.	
	“Contract Documents” means the documents listed in Article 1.1 (Contract Documents) of the Form of Contract Agreement (including any amendments thereto).	
	“GCC” means the General Conditions of Contract hereof.	
	“SCC” means the Special Conditions of Contract.	
	“Day” means calendar day of the Gregorian Calendar.	
	“Month” means calendar month of the Gregorian Calendar.	
	“Employer” means the person named as such in the SCC and includes the legal successors or permitted assigns of the Employer.	
	“Project Manager” means the person appointed by the Employer in the manner provided in GCC Sub-Clause 17.1 (Project Manager) hereof and named as such in the SCC to perform the duties delegated by the Employer.	
	“Contractor” means the person(s) whose bid to perform the Contract has been accepted by the Employer and is named as such in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.	
	“Contractor’s Representative” means any person nominated by the Contractor and approved by the Employer in the manner provided in GCC Sub-Clause 17.2 (Contractor’s Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.	
	“Subcontractor”, including vendors, means any person to whom execution of any part of the Facilities, including preparation of any design or supply of any Plant and Equipment, is sub-contracted directly or indirectly by the Contractor, and includes its legal successors or permitted assigns.	
	“Adjudicator” means the person or persons named as such in the SCC to make a decision on or to settle any dispute or difference between the Employer and the Contractor referred to him or her by the parties pursuant to GCC Sub-Clause 6.1 (Adjudicator) hereof.	
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - IV (GCC)
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)
	“Contract Price” means the sum specified in Article 2.1 (Contract Price) of the Contract Agreement, subject to such additions and adjustments thereto or deductions therefrom, as may be made pursuant to the Contract. “Facilities” means the Plant and Equipment to be supplied and installed, as well as all the Installation Services to be carried out by the Contractor under the Contract. “Plant and Equipment” means permanent plant, equipment, machinery, apparatus, articles and things of all kinds to be provided and incorporated in the Facilities by the Contractor under the Contract (including the spare parts to be supplied by the Contractor under GCC Sub-Clause 7.3 hereof), but does not include Contractor’s Equipment. “Installation Services” means all those services ancillary to the supply of the Plant and Equipment for the Facilities, to be provided by the Contractor under the Contract; e.g., transportation and provision of marine or other similar insurance, inspection, expediting, Site preparation works (including the provision and use of Contractor’s Equipment and the supply of all civil, structural and construction materials required), installation, Precommissioning, commissioning, carrying out guarantee tests, operations, maintenance, the provision of operations and maintenance manuals, training of Employer’s personnel etc. “Contractor’s Equipment” means all plant, facilities, equipment, machinery, tools, apparatus, appliances or things of every kind required in or for installation, completion and maintenance of Facilities that are to be provided by the Contractor, but does not include Plant and Equipment, or other things intended to form or forming part of the Facilities. “Site” means the land and other places upon which the Facilities are to be installed, and such other land or places as may be specified in the Contract as forming part of the Site. “Effective Date” means the date from which the Time for Completion shall be determined as stated in Article 3 (Effective Date for Determining Time for Completion) of the Form of Contract Agreement. “Time for Completion” means the time within which Completion of the Facilities as a whole (or of a part of the Facilities where a separate Time for Completion of such part has been prescribed) is to be attained in accordance with the stipulations in the SCC and the relevant provisions of the Contract. “Completion” means that the Facilities (or a specific part thereof where specific parts are specified in the SCC) have been completed operationally and structurally and put in a tight and clean condition and that all work in respect of Precommissioning of the Facilities or such specific part thereof has been completed and Commissioning has been attained as per Technical Specifications.
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)		
	“Precommissioning” means the testing, checking and other requirements specified in the Technical Specifications that are to be carried out by the Contractor in preparation for Commissioning as provided in GCC Clause 24 (Commissioning and Completion of Facilities) hereof. “Commissioning” means operation of the Facilities or any part thereof by the Contractor, which is to be carried out by the Contractor as provided in GCC Sub-Clause 24 (Commissioning and Completion of Facilities) hereof, for the purpose of carrying out Guarantee Test(s). “Guarantee Test(s)” means the test(s) specified in the Technical Specifications to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Functional Guarantees specified in the Technical Specifications in accordance with the provisions of GCC Sub-Clause 25.1 (Guarantee Test) hereof. “Operational Acceptance” means the acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor’s fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of GCC Clause 28 (Functional Guarantees) hereof and shall include deemed acceptance in accordance with GCC Clause 25 (Guarantee Tests and Operational Acceptance) hereof. “Defect Liability Period” means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof) as provided in GCC Clause 27 (Defect Liability) hereof.		
2.	Contract Documents 2.1 Subject to Article 1.2 (Order of Precedence) of the Contract Agreement, all documents forming part of the Contract (and all parts thereof) are intended to be correlative, complementary and mutually explanatory. The Contract shall be read as a whole. 2.2 The Contract will be signed in three originals and the Contractor shall be provided with one signed original and the rest will be retained by the Employer. 2.3 The Contractor shall provide free of cost to the Employer all the engineering data, drawing and descriptive materials submitted with the bid, in at least six (6) copies to form a part of the Contract immediately after Notification of Award. 2.4 Subsequent to signing of the Contract, the Contractor at his own cost shall provide the Employer with at least twenty (20) true copies and three (3) soft copies on CD-ROM of the Contract Agreement within thirty (30) days after signing of the Contract.		
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
3. Interpretation	3.1 Language	
	3.1.1	Unless the Contractor is a national of the Employer's country and the Employer and the Contractor agree to use the local language, all Contract Documents, all correspondence and communications to be given, and all other documentation to be prepared and supplied under the Contract shall be written in English, and the Contract shall be construed and interpreted in accordance with that language.
	3.1.2	If any of the Contract Documents, correspondence or communications are prepared in any language other than the governing language under GCC Sub-Clause 3.1.1 above, the English translation of such documents, correspondence or communications shall prevail in matters of interpretation.
	3.2	Singular and Plural
		The singular shall include the plural and the plural the singular, except where the context otherwise requires.
	3.3	Headings
		The headings and marginal notes in the General Conditions of Contract are included for ease of reference, and shall neither constitute a part of the Contract nor affect its interpretation.
	3.4	Persons
		Words importing persons or parties shall include firms, corporations and government entities.
	3.5	Incoterms
		Unless inconsistent with any provision of the Contract, the meaning of any trade term and the rights and obligations of parties thereunder shall be as prescribed by Incoterms.
		Incoterms means international rules for interpreting trade terms published by the International Chamber of Commerce (latest edition), 38 Cours Albert 1er, 75008 Paris, France.
	3.6	Construction of the Contract
	3.6.1	The Contracts to be entered into between the Employer and the successful bidder shall be as under :
		For Foreign Bidder
		-- 'First Contract' for CIF (Indian port-of-entry) supply of all Plant and Equipment including mandatory spares to be supplied from abroad.
		-- 'Second Contract' for Ex-works (India) supply of all Plant and Equipment including mandatory spares of Indian origin.
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)
	– 'Third Contract' for providing all services i.e. port handling, port clearance and port charges for the imported goods, further loading and inland transportation for delivery at site, inland transit insurance, unloading, storage, handling at site, installation, insurance covers other than inland transit insurance, testing and commissioning including carrying out guarantee tests in respect of all the equipment supplied under the First Contract and the Second Contract and all other services specified in the Contract Documents. If the foreign bidder has proposed an Assignee in his bid to execute the Second Contract and/or the Third Contract and has also furnished written unequivocal consent of the proposed Assignee to work as independent Contractor on the terms and conditions offered by the bidder and if the Employer is satisfied with capacity and experience of the Assignee, the Employer will enter into the 'Second Contract' and/or 'Third Contract' with the said Assignee. In case no Assignee has been proposed by the foreign bidder in his bid or if the Assignee fails to enter into the Second Contract and/or Third Contract with the Employer or if the Employer in its judgement does not find acceptance of the proposed Assignee as its Contractor, then the foreign bidder shall be obliged to enter into and execute all the three Contracts with the Employer. If the Employer accepts to enter into Second Contract and/or Third Contract with the Assignee of foreign bidder, the said Assignee, in addition to the Contract Performance Securities to be provided by the foreign Contractor for ten percent (10%) of the value of all the three Contracts, i.e. First Contract, Second Contract and Third Contract shall provide within twenty eight (28) days of Notification of Award, separate Contract Performance Security(ies) equivalent to ten percent (10%) of the value of the Contract(s) entered into with the Assignee for the due performance of the Contract, with an initial validity upto ninety (90) days beyond the scheduled Defect Liability Period of the last equipment covered under the Contract. For Domestic Bidder -- 'First Contract' for CIF (Indian port-of-entry) supply of all Plant and Equipment including mandatory spares to be supplied from abroad. -- 'Second Contract' for Ex-works (India) supply of all the Plant and Equipment including mandatory spares of Indian origin. -- 'Third Contract' for providing all services i.e. port handling, port clearance and port charges for the imported goods, further loading, inland transportation for delivery at site, inland transit insurance, unloading, storage, handling at site, installation,
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
	insurance covers other than inland transit insurance, testing and commissioning including carrying out guarantee tests in respect of all the Plant and Equipment supplied under the 'First Contract' and 'Second Contract' and all other services specified in the Contract Documents. 3.6.2 The award of separate Contracts shall not in any way dilute the responsibility of the Contractor for the successful completion of the Facilities as per Contract Documents and a breach in one Contract shall automatically be construed as a breach of the other Contract(s) which will confer a right on the Employer to terminate the other Contract(s) also at the risk and the cost of the Contractor. 3.7 Entire Agreement Subject to GCC Sub-Clause 16.4 hereof, the Contract constitutes the entire agreement between the Employer and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations and agreements (whether written or oral) of parties with respect thereto made prior to the date of Contract. 3.8 Amendment No amendment or other variation of the Contract shall be effective unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each party hereto. 3.9 Independent Contractor The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture or other joint relationship between the parties hereto. Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of the Employer, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives or Subcontractors and the Employer. 3.10 Joint Venture or Consortium If the Contractor is a joint venture or consortium of two or more firms, all such firms shall be jointly and severally bound to the Employer for the fulfillment of the obligations under the Contract and shall designate one of such firms to act as a leader with authority to bind the joint venture or consortium. The composition or the constitution of the joint venture or consortium shall not be altered without the prior consent of the Employer. 3.11 Non-Waiver 3.11.1 Subject to GCC Sub-Clause 3.11.2 below, no relaxation, forbearance, delay or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting	
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)		
		of time by either party to the other shall prejudice, affect or restrict the rights of that party under the Contract, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract. 3.11.2 Any waiver of a party's rights, powers or remedies under the Contract must be in writing, must be dated and signed by an authorized representative of the party granting such waiver, and must specify the right and the extent to which it is being waived. 3.12 Severability If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract. 3.13 Country of Origin "Origin" means the place where the materials, equipment and other supplies for the Facilities are mined, grown, produced or manufactured and from which the services are provided.	
4.	Notices	4.1 Unless otherwise stated in the Contract, all notices to be given under the Contract shall be in writing, and shall be sent by personal delivery, special courier, post or telefax followed by post confirmation to the address of the relevant party set out in the Contract Coordination Procedure to be finalised pursuant to GCC Sub-Clause 17.2.3.1, with the following provisions. 4.1.1 Any notice sent by telefax shall be confirmed within two (2) days after despatch by notice sent by post confirmation, except as otherwise specified in the Contract. 4.1.2 Any notice sent by post or special courier shall be deemed (in the absence of evidence of earlier receipt) to have been delivered ten (10) days after despatch. In proving the fact of despatch, it shall be sufficient to show that the envelope containing such notice was properly addressed, stamped and conveyed to the postal authorities or courier service for transmission by airmail or special courier. 4.1.3 Any notice delivered personally or sent by telefax shall be deemed to have been delivered on date of its despatch. 4.1.4 Either party may change its postal address, telefax number and addressee for receipt of such notices by ten (10) days' notice to the other party in writing. 4.2 Notices shall be deemed to include any approvals, consents, instructions, orders and certificates to be given under the Contract.	
5.	Governing Law	5.1 The Contract shall be governed by and interpreted in accordance with laws in force in India. The Courts of Delhi shall have exclusive jurisdiction in all matters arising under the Contract.	
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
6. Settlement of Disputes	6.1 Adjudicator	
	6.1.1	If any dispute of any kind whatsoever shall arise between the Employer and the Contractor in connection with or arising out of the Contract, including without prejudice to the generality of the foregoing, any question regarding its existence, validity or termination, or the execution of the Facilities—whether during the progress of the Facilities or after their completion and whether before or after the termination, abandonment or breach of the Contract—the parties shall seek to resolve any such dispute or difference by mutual consultation. If the parties fail to resolve such a dispute or difference by mutual consultation, then the dispute shall be referred in writing by either party to the Adjudicator, with a copy to the other party.
	6.1.2	The Adjudicator shall give its decision in writing to both parties within twenty-eight (28) days of a dispute being referred to it. If the Adjudicator has done so, and no notice of intention to commence arbitration has been given by either the Employer or the Contractor within fifty-six (56) days of such reference, the decision shall become final and binding upon the Employer and the Contractor. Any decision that has become final and binding shall be implemented by the parties forthwith.
	6.1.3	Should the Adjudicator resign or die, or should the Employer and the Contractor agree that the Adjudicator is not fulfilling its functions in accordance with the provisions of the Contract, another retired Judge of High Court / Supreme Court of India shall be jointly appointed by the Employer and the Contractor as Adjudicator under the Contract. Failing agreement between the two, within twenty eight (28) days, the new retired Judge of High Court/ Supreme Court of India shall be appointed as Adjudicator under the Contract at the request of either party by the Appointing Authority specified in the SCC. The Adjudicator shall be paid fee plus reasonable expenditures incurred in the execution of its duties as Adjudicator under the Contract. These costs shall be divided equally between the Employer and the Contractor.
	6.2 Arbitration	
	6.2.1	If either the Employer or the Contractor is dissatisfied with the Adjudicator's decision, or if the Adjudicator fails to give a decision within twenty-eight (28) days of a dispute being referred to it, then either the Employer or the Contractor may, within fifty-six (56) days of such reference, give notice to the other party, with a copy for information to the Adjudicator, of its intention to commence arbitration, as hereinafter provided, as to the matter in dispute, and no arbitration in respect of this matter may be commenced unless such notice is given.
	6.2.2	Any dispute in respect of which a notice of intention to commence arbitration has been given, in accordance with GCC
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
	Sub-Clause 6.2.1, shall be finally settled by arbitration. Arbitration may be commenced prior to or after completion of the Facilities. 6.2.3 Any dispute submitted by a party to arbitration shall be heard by an arbitration panel composed of three arbitrators, in accordance with the provisions set forth below. 6.2.4 The Employer and the Contractor shall each appoint one arbitrator, and these two arbitrators shall jointly appoint a third arbitrator, who shall chair the arbitration panel. If the two arbitrators do not succeed in appointing a third arbitrator within twenty-eight (28) days after the latter of the two arbitrators has been appointed, the third arbitrator shall, at the request of either party, be appointed by the Appointing Authority for arbitrator designated in the SCC. 6.2.5 If one party fails to appoint its arbitrator within forty-two (42) days after the other party has named its arbitrator, the party which has named an arbitrator may request the Appointing Authority to appoint the second arbitrator. 6.2.6 If for any reason an arbitrator is unable to perform its function, the mandate of the Arbitrator shall terminate in accordance with the provisions of applicable laws as mentioned in GCC Clause 5(Governing Law) and a substitute shall be appointed in the same manner as the original arbitrator. 6.2.7 Arbitration proceedings shall be conducted (i) in accordance with the rules of procedure designated in the SCC, (ii) in the place designated in the SCC, and (iii) in the language in which this Contract has been executed. 6.2.8 The decision of a majority of the arbitrators (or of the third arbitrator chairing the arbitration panel, if there is no such majority) shall be final and binding and shall be enforceable in any court of competent jurisdiction as decree of the court. The parties thereby waive any objections to or claims of immunity from such enforcement. 6.2.9 The arbitrator(s) shall give reasoned award. 6.3 Notwithstanding any reference to the Adjudicator or arbitration herein, (a) the parties shall continue to perform their respective obligations under the Contract unless they otherwise agree (b) the Employer shall pay the Contractor any monies due to the Contractor.	
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Clause No.		GENERAL CONDITIONS OF CONTRACT (GCC)	
B. Subject Matter of Contract			
7.	Scope of Facilities	7.1	Unless otherwise expressly limited in the Technical Specifications, the Contractor's obligations cover the provision of all Plant and Equipment including spares and the performance of all Services required for the design, the manufacture (including procurement, quality assurance, construction, installation, associated civil, structural and other construction works, Precommissioning and delivery) of the Plant and Equipmen and the installation, commissioning, completion of the facilities and carrying out guarantee tests for the facilities in accordance with the plans, procedures, specifications, drawings, codes and any other documents as specified in the Technical Specifications. Such specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labour, materials, equipment, spare parts (as specified in GCC Sub-Clause 7.3 below) and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures and facilities; transportation (including, without limitation, unloading and hauling to, from and at the Site), insurance and storage, except for those supplies, works and services that will be provided or performed by the Employer, as set forth in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement.
		7.2	The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining Completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract.
		7.3	In addition to the supply of Mandatory Spare Parts included in the Contract, the Contractor agrees to supply spare parts required for the operation and maintenance of the Facilities. However, the identity, specifications and quantities of such spare parts and the terms and conditions relating to the supply thereof are to be agreed between the Employer and the Contractor, and the price of such spare parts shall be that given in Price Schedule No. 6, which shall be added to the Contract Price. The price of such spare parts shall include the purchase price therefor and other costs and expenses (including the Contractor's fees) relating to the supply of spare parts. The prices of spares covered under Price Schedule No.6 shall be kept valid for a period as specified in the SCC.
		7.3.1	The Contractor agrees that the spare parts recommended by him for 3 years operation and quoted in Schedule No. 6 shall be supplied by him at the same terms and conditions as are otherwise applicable to this Contract. Further, the Contractor also agrees to supply spare parts required for the operation and maintenance of the Facilities as per provision of subsequent paragraphs of this Sub-Clause.
		7.3.1.1	All the spares for the equipment under the Contract will strictly conform to the Specification and other relevant documents and
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Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)
	will be identical to the corresponding main equipment/components supplied under the Contract and shall be fully interchangeable.
7.3.1.2	All the mandatory spares covered under the Package shall be produced alongwith the main equipment as a continuous operation and the delivery of the mandatory spares will be effected alongwith the main equipment in a phased manner and the delivery would be completed by the respective dates for the various categories of equipment as per the agreed network. In case of recommended spares, the above will be applicable provided the order for the recommended spares have been placed with the Contractor prior to commencement of manufacture of the main equipment.
7.3.1.3	The Contractor will provide the Employer with the manufacturing drawings, catalogues, assembly drawings and any other document required by the Employer so as to enable the Employer to identify the recommended spares. Such details will be furnished to the Employer as soon as they are prepared but in any case not later than six months prior to commencement of manufacture of the corresponding main equipment.
7.3.1.4	To enable the Employer to finalise the requirement of recommended spares which are ordered subsequent to placement of order for main equipment/plant, in addition to necessary technical details, catalogue and such other information brought-out herein above, the Contractor will also provide a justification in support of reasonableness of the quoted prices of spares which will, inter-alia, include documentary evidence that the prices quoted by the Contractor to the Employer are not higher than those charged by him from other customers in the same period.
7.3.1.5	In addition to the spares recommended by the Contractor, if the Employer further identifies certain items of spares, the Contractor will submit the prices and delivery quotation for such spares within thirty (30) days of receipt of such request with a validity period of six (6) months for consideration by the Employer and placement of order for additional spares, if the Employer so desires.
7.3.1.6	The quality plan and the inspection requirement finalised for the main equipment will also be applicable to the corresponding spares.
7.3.1.7	The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/equipment covered under the Contract and will further ensure with his vendors that the Employer, 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.
7.3.1.8	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall guarantee that before going out
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	of production of spare parts of the equipment covered under the Contract, he shall give the Employer atleast 2 years advance notice so that the latter may order his bulk requirement of spares, if it so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-contractor, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specification and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items. 7.3.1.9 The prices of all future requirements of item of spares beyond 3 years operational requirement will be derived from the corresponding ex-works price at which the order for such spares have been placed by Employer as a part of mandatory spares or recommended spares, or from the rates of mandatory spares or recommended spares as quoted by/negotiated with the Contractor. Ex-works order price of future spares shall be computed in accordance with the price adjustment provisions covered under the main Contract excepting that the base indices will be counted from the scheduled date of completion of facilities of the last equipment under the main contract and there will be no ceiling on the amount of variation in the prices. The above option for procuring future recommended spares by the Employer shall remain valid for the period of 5 years from the scheduled date of completion of facilities of the last equipment covered under this contract. 7.3.1.10 The Contractor will indicate in advance the delivery period of the items of spares, which the Employer may procure in accordance with above sub-clause. In case of emergent requirements of spares, the Contractor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule. 7.3.1.11 In case the Contractor fails to supply the mandatory, recommended or long term spares in the terms stipulated above, the Employer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the Contractor and recover from the Contractor, the excess amount paid by the Employer, if any, over the rates worked on the above basis. In the event of such risk purchase by the Employer, the purchases will be as per the Works and Procurement Policy of the Employer prevalent at the time of such purchases and the Employer at his option may include a representative from the Contractor in finalising the purchases. 7.3.1.12 It is expressly understood that the final settlement between the parties, in terms of relevant clauses of the Contract Documents shall not relieve the Contractor of any of his obligations under the provision of long term availability of spares and such provisions
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	shall continue to be enforced till the expiry of 5 years period reckoned from the scheduled date of completion of facilities of the last equipment covered under this Contract, unless otherwise discharged expressly in writing by the Employer. Further, the provisions pertaining to long term availability of spares shall be extended beyond 5 years applicability period mentioned herein above if so desired by the Employer and at the mutually acceptable escalation formula. 7.3.1.13 The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship and shall further guarantee as under : (i) For 3 years operational spares (both mandatory and recommended) a) For any item of spares ordered or to be ordered by the Employer for 3 years operational requirement of the plant which are manufactured as a continuous operation together with the main equipment, the Defect Liability Period will be twelve (12) months from the scheduled date of commercial operation of the last unit of main equipment/plant covered under the Contract. 'Commercial Operation' shall mean the conditions of operation in which the complete equipment covered under the Contract is officially declared by the Employer to be available for continuous operation at different loads upto and including rated capacity. Such declaration by the Employer, however, shall not relieve or prejudice the Contractor any of his obligations under the Contract. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts, if any, supplied will be replaced without any extra cost to the Employer unless a joint examination and analysis by the Employer and the Contractor of such spare parts prove that the defect found in the original part that failed, can safely be assumed not to be present in spare parts. Such replaced spare parts will have the same Defect Liability as applicable to the replacement made for the defective original part/component provided that such replacement for the original equipment and the spare replaced are again manufactured together. The discarded spare parts will become the property of the Contractor as soon as they have been replaced by the Contractor. b) For the item of spares ordered or to be ordered by the Employer for 3 years operational requirement of the plant, which, with the written approval of the Employer,
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		are not manufactured along with the main equipment as a continuous operation, will be warranted for 7000 hrs of trouble free operation if used within a period of eighteen (18) months reckoned from the date of actual delivery at site. However, if such spare parts are put to use after eighteen (18) months of actual delivery at Site then the guarantee of such spares will stand valid till the expiry of thirty six (36) months from the scheduled date of completion of facilities for the last unit of equipment/plant covered under the contract or 7000 hrs of trouble free operation after such spares are put in service, whichever is earlier. c) For long term requirement For item of spares that may be ordered by the employer to cover requirements beyond 3 years of Initial Operation of the plant, the warranty will be till the expiry of 7000 hrs of trouble free operation if used within a period of 18 months from the date of actual delivery at site. For item of spares that may be used after 18 months from the date of actual delivery at site, the warranty period will be 12 months from the date they are put to use or 7000 hrs of trouble free operation, whichever is earlier. In any case the defect liability of spares will expire at the end of 48 months from the date of their receipt at site. ii) The Defect Liability of spares covered in para (b) and (c) above, that are not used within 18 months from the respective date of actual delivery at Site will, however, be subject to condition that all such spares have been stored/maintained/preserved in accordance with Contractor's standard recommended practice, if any, furnished to the Employer.	
8. Time for Commencement and Completion	8.1 8.2	The Contractor shall commence work on the Facilities from the date of Notification of Award and without prejudice to GCC Sub-Clause 26.2 hereof. The Contractor shall thereafter proceed with the Facilities in accordance with the time schedule specified in Appendix 4 (Time Schedule) to the Contract Agreement. The Contractor shall attain Completion of the Facilities (or of a part where a separate time for Completion of such part is specified in the Contract) within the time stated in the SCC or within such extended time to which the Contractor shall be entitled under GCC Clause 40 (Extension of Time for Completion) hereof.	
9. Contractor's Responsibilities	9.1	The Contractor shall design, manufacture (including associated purchases and/or subcontracting), install and complete the Facilities and	
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		carry out the Guarantee tests with due care and diligence in accordance with the Contract.	
	9.2	The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities (including any data as to boring tests) provided by the Employer, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site (if access thereto was available) and of other data readily available to it relating to the Facilities as at the date twenty-eight (28) days prior to bid submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities.	
	9.3	The Contractor shall acquire in its name all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located that are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall also acquire all other permits, approvals and/or licenses that are not the responsibility of the Employer under GCC Sub-Clause 10.3 hereof and that are necessary for the performance of the Contract.	
	9.4	The Contractor shall comply with all laws in force in the country where the Facilities are installed and where the Installation Services are carried out. The laws will include all national, provincial, municipal or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to GCC Sub-Clause 10.1 hereof.	
	9.5	Any Plant, Material and Services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under GCC Clause 3.13 (Country of Origin).	
10.	Employer's Responsibilities	10.1	The Employer shall ensure the accuracy of all information and/or data to be supplied by the Employer as described in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract, except when otherwise expressly stated in the Contract.
		10.2	The Employer shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement. The Employer shall give full possession of
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	and accord all rights of access thereto on or before the date(s) specified in Appendix 6. 10.3 The Employer shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located, which such authorities or undertakings require the Employer to obtain in the Employer's name for the execution of the Contract (they include those required for the performance by both the Contractor and the Employer of their respective obligations under the Contract), including those specified in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement. 10.4 If requested by the Contractor, the Employer shall use its best endeavors to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals and/or licenses necessary for the execution of the Contract from all local, state or national government authorities or public service undertakings that such authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain. 10.5 The Employer shall provide sufficient, properly qualified operating and maintenance personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities and shall perform work and services of whatsoever nature, all as specified in Appendix-6 (Scope of Works and Supply by the Employer) to the Contract Agreement, to enable the Contractor to properly carry out Precommissioning, Commissioning and Guarantee Tests at or before the time specified in the program furnished by the Contractor under GCC Sub-Clause 18.2 (Program of Performance) hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor. 10.6 The Employer shall be responsible for the continued operation of the Facilities after Completion, in accordance with GCC Sub-Clause 24.9, and shall be responsible for facilitating the Guarantee Test(s) for the Facilities, in accordance with GCC Sub-Clause 25.1. 10.7 All costs and expenses involved in the performance of the obligations under this GCC Clause 10 shall be the responsibility of the Employer, save those to be incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with GCC Sub-Clause 25.1. C. Payment	
11. Contract Price	11.1 The Contract Price shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement. 11.2 The Contract Price shall be adjusted in accordance with provisions of Appendix-2 (Price Adjustment) to the Contract Agreement.	
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12. Terms of Payment	11.3	Subject to GCC Sub-Clauses 9.2, 10.1 and 35 (Unforeseen Conditions) hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.
	12.1	The Contract Price shall be paid as specified in Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement. The procedures to be followed in making application for and processing payments shall be those outlined in the same Appendix 1.
	12.2	No payment made by the Employer herein shall be deemed to constitute acceptance by the Employer of the Facilities or any part(s) thereof.
13. Securities	12.3	The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor's bid.
	13.1	Issuance of Securities The Contractor shall provide the securities specified below in favor of the Employer at the times, and in the amount, manner and form specified below.
	13.2	Advance Payment Security 13.2.1 The Contractor shall, within twenty-eight (28) days of the Notification of Award of Contract, provide a security in an amount equal to the advance payment calculated in accordance with Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, and in the currency or currencies of the Contract, with a initial validity of up to ninety (90) days beyond the schedule date of Completion of the last facility covered under the package in accordance with GCC Clause 24. However, in case of delay in completion of the facilities under the package, the validity of this security shall be extended by the period of such delay.
	13.2.2	The security shall be in the form of an unconditional bank guarantee as per the proforma provided in Section VII (Forms and Procedures)- Form of Advance Payment Security. The Advance payment Security shall be reduced prorata every three (3) months after First Running Account Bill/Stage Payment under the Contract based on the value of the respective equipment/facilities received. The cumulative amount of reduction at any point of time shall not exceed seventy five percent (75%) of the advance corresponding to cumulative value of the respective equipment/Facilities supplied and received as per certificate issued by the Project Manager. The balance of 25% shall be released on Completion of those Facilities. It should be clearly understood that reduction in the value of security for advance shall not in any way dilute the Contractor's
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	responsibility and liabilities under the Contract including in respect of the Facilities for which the reduction in the value of security is allowed. 13.3 Contract Performance Security 13.3.1 The Contractor shall, within twenty-eight (28) days of the Notification of Award, provide securities for due performance of the Contracts for ten percent (10%) of the Contract Price of all the Contracts, with a initial validity upto ninety(90) days beyond the end of scheduled Defect Liability Period of the last equipment covered under the package. If the Employer accepts to enter into Contract with the Assignee of a foreign Contractor, pursuant to GCC Sub-Clause 3.6, the said Assignee, in addition to the Contract Performance Securities to be provided by the foreign Contractor for ten percent (10%) of the value of all the Contracts i.e. First Contract, Second Contract and Third Contract shall provide within twenty eight (28) days of the Notification of Award, a separate Contract Performance Security equivalent to ten percent (10%) of the value of Contract entered into with the assignee, for the due performance of Contract, with a initial validity upto Ninety (90) days beyond the end of scheduled Defect Liability Period of the last equipment covered under the Package. However, in case of delay in completion of the defect liability period, the validity of all the contract performance securities shall be extended by the period of such delay. 13.3.2 The Performance Securities shall be denominated in the currency or currencies of the Contract or in a freely convertible currency acceptable to the Employer and shall be in the form of unconditional bank guarantee provided in Section VII (Forms and Procedures)- Form of Performance Security of the bidding Documents. 13.3.3 Unless otherwise stipulated in SCC, the security shall be reduced pro rata to the Contract Price of a part of the Facilities for which a separate time for Completion is provided, twenty one (21) months after Completion of the Facilities (or where relevant part thereof) or fifteen (15) months after Operational Acceptance of the Facilities (or where relevant part thereof), whichever occurs first; provided, however, that if the Defects Liability Period has been extended on any part of the Facilities pursuant to GCC Sub-Clause 27.8 hereof, the Contractor shall issue an additional security in an amount proportionate to the Contract Price of that part. The security shall be returned to the Contractor immediately after its expiration, provided, however, that if the Contractor, pursuant to GCC Sub-Clause 27.10, is liable for an extended warranty obligation, the performance security shall be extended for the period and up to the amount agreed upon or as specified in SCC. 14. Taxes and Duties 14.1 Except as otherwise specifically provided in the Contract, the Contractor shall bear and pay all taxes, duties, levies and charges assessed on the
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	Contractor, its Subcontractors or their employees by all municipal, state or national government authorities in connection with the Facilities in and outside of the country where the Site is located. 14.2 Notwithstanding GCC Sub-Clauses 14.1 above, the Employer shall bear and promptly pay/reimburse all customs and import duties, if imposed in future, on the Plant and Equipment including mandatory spares supplied from abroad and specified in Price Schedule No. 1 (and on spare parts to be supplied from abroad and specified in Schedule No.6, when awarded) and that are to be incorporated into the Facilities by the law of the country where the Site is located. However, if the plant and equipment are shipped in Shipper's containers, then the custom duty levied on the cost of empty containers shall be borne and paid/reimbursed by the Contractor. The Employer shall also bear and pay/reimburse to the Contractor/Assignee of Foreign Contractor (if applicable) Sales Tax (but not the surcharge in lieu of Sales Tax), Local Tax including Entry Tax/Octroi (if applicable) in respect of direct transactions between the Employer and the Contractor, if imposed on the Plant and Equipment including Mandatory Spares manufactured within the Employer's country and specified in Price Schedule No. 2 (and also on locally supplied spares quoted in Schedule No.6, when awarded) to be incorporated in the Facilities, by the law of country where the Site is located. For this purpose, the Ex-works price if quoted in foreign currency and so incorporated in the Contract, shall be converted to Indian Rupees as per the TT buying exchange rates established by State Bank of India prevailing on the actual date of Ex-works (India) despatch. Employer will issue the requisite sales tax declaration form(s) in order to get the benefit of any concession in the rate of sales tax. Further, in case of all components, equipments and materials identified by the Contractor and NTPC to be despatched directly from the sub-vendor's work to NTPC site in a State different from the State wherein sub-vendor's works are located, the Contractor shall effect sale in transit. For effecting the sale in transit, the Contractor shall ensure that his sub-vendor raises invoices in the Contractor's name (and not in the name of NTPC) and obtains GR/LR/RR in the name of Contractor (and not in the name of NTPC). The Contractor shall further ensure that he endorses the GR/LR/RR in the name of NTPC during transit of the equipment before the delivery of equipments is taken by NTPC. All taxes, duties and levies on works contract, if any, shall be to the contractor's account and no separate claim in this regard will be entertained by the Employer. 14.3 If any tax exemptions, reductions, allowances or privileges is available to the Contractor in the country where the Site is located, the Employer shall use its best endeavors to enable the Contractor to benefit from any such tax savings to the maximum allowable extent.
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	14.4 For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies and charges prevailing at the date seven (7) days prior to the last date of bid submission in the country where the Site is located (hereinafter called "Tax" in this GCC Sub-Clause 14.4). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor in connection with performance of the Contract, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be, in accordance with GCC Clause 36 (Change in Laws and Regulations) hereof. However, these adjustments would be restricted to direct transactions between the Employer and the Contractor/ assignee of Foreign Contractor (if applicable). These adjustments shall not be applicable on procurement of raw materials, intermediary components etc. by the Contractor/assignee and also not applicable on the bought out items despatched directly from sub-vendor's works to site. Further, no adjustment of the Contract Price and/or payment/ reimbursement of taxes, duties or levies shall be made on account of variation in or withdrawal of deemed export benefits. D. Intellectual Property	
15. Copyright	15.1 The copyright in all drawings, documents and other materials containing data and information furnished to the Employer by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Employer directly or through the Contractor by any third party, including suppliers of materials, the copyright in such materials shall remain vested in such third party. The Employer shall however be free to reproduce all drawings, documents and other material furnished to the Employer for the purpose of the contract including, if required, for operation and maintenance of the facilities.	
16. Confidential Information	16.1 The Employer and the Contractor shall keep confidential and shall not, without the written consent of the other party hereto, divulge to any third party any documents, data or other information furnished directly or indirectly by the other party hereto in connection with the Contract, whether such information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this GCC Clause 16. 16.2 The Employer shall not use such documents, data and other information received from the Contractor for any purpose other than execution of the Contract and operation and maintenance of the Facilities. Similarly, the	
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	Contractor shall not use such documents, data and other information received from the Employer for any purpose other than the design, procurement of Plant and Equipment, construction or such other work and services as are required for the performance of the Contract. 16.3 The obligation of a party under GCC Sub-Clauses 16.1 and 16.2 above, however, shall not apply to that information which (a) now or hereafter enters the public domain through no fault of that party (b) can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party hereto (c) otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality. 16.4 The above provisions of this GCC Clause 16 shall not in any way modify any undertaking of confidentiality given by either of the parties hereto prior to the date of the Contract in respect of the Facilities or any part thereof. 16.5 The provisions of this GCC Clause 16 shall survive termination, for whatever reason, of the Contract. E. Work Execution	
17. Representatives	17.1 Project Manager If the Project Manager is not named in the Contract, then within fourteen (14) days of the Effective Date, the Employer shall appoint and notify the Contractor in writing of the name of the Project Manager. The Employer may from time to time appoint some other person as the Project Manager in place of the person previously so appointed, and shall give a notice of the name of such other person to the Contractor without delay. The Employer shall take reasonable care to see that no such appointment is made at such a time or in such a manner as to impede the progress of work on the Facilities. The Project Manager shall represent and act for the Employer at all times during the currency of the Contract. All notices, instructions, orders, certificates, approvals and all other communications under the Contract shall be given by the Project Manager, except as herein otherwise provided. All notices, instructions, information and other communications given by the Contractor to the Employer under the Contract shall be given to the Project Manager, except as herein otherwise provided. 17.2 Contractor's Representative & Construction Manager 17.2.1 If the Contractor's Representative is not named in the Contract, then within fourteen (14) days of the Effective Date, the Contractor	
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17.2.2	shall appoint the Contractor's Representative and shall request the Employer in writing to approve the person so appointed. If the Employer makes no objection to the appointment within fourteen (14) days, the Contractor's Representative shall be deemed to have been approved. If the Employer objects to the appointment within fourteen (14) days giving the reason therefor, then the Contractor shall appoint a replacement within fourteen (14) days of such objection, and the foregoing provisions of this GCC Sub-Clause 17.2.1 shall apply thereto. The Contractor's Representative shall represent and act for the Contractor at all times during the currency of the Contract and shall give to the Project Manager all the Contractor's notices, instructions, information and all other communications under the Contract. All notices, instructions, information and all other communications given by the Employer or the Project Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided. The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in GCC Sub-Clause 17.2.1.
17.2.3	The Contractor's Representative may, subject to the approval of the Employer (which shall not be unreasonably withheld), at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to the Employer and the Project Manager. Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this GCC Sub-Clause 17.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.
17.2.3.1	Notwithstanding anything stated in GCC Sub-clause 17.1 and 17.2.1 above, for the purpose of execution of contract, the Employer and the Contractor shall finalise and agree to a Contract Co-ordination Procedure and all the communication under the Contract shall be in accordance with such Contract Co-ordination Procedure.
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17.2.4	From the commencement of installation of the Facilities at the Site until Operational Acceptance, the Contractor's Representative shall appoint a suitable person as the construction manager (hereinafter referred to as "the Construction Manager"). The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site throughout normal working hours except when on leave, sick or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, a suitable person shall be appointed to act as his or her deputy.	
17.2.5	The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under GCC Sub-Clause 22.3. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities/Site.	
17.2.6	If any representative or person employed by the Contractor is removed in accordance with GCC Sub-Clause 17.2.5, the Contractor shall, where required, promptly appoint a replacement.	
18. Work Program	18.1 Contractor's Organization	The Contractor shall supply to the Employer and the Project Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities. The chart shall include the identities of the key personnel together with the curricula vitae of such key personnel to be employed within twenty-one (21) days of the Effective Date. The Contractor shall promptly inform the Employer and the Project Manager in writing of any revision or alteration of such an organization chart.
	18.2 Program of Performance	Within twenty-eight (28) days after the date of Notification of Award of Contract, the Contractor shall prepare and submit to the Project Manager a detailed program of performance of the Contract, made in the form of PERT network and showing the sequence in which it proposes to design, manufacture, transport, assemble, install & commission the Facilities and deliver the mandatory spares at site as well as the date(s) by which the Contractor reasonably requires that the Employer shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in Appendix 4 (Time Schedule) to the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Project Manager, but without
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	modification in the Times for Completion given in the SCC and any extension granted in accordance with GCC Clause 40, and shall submit all such revisions to the Project Manager. 18.3 Progress Report The Contractor shall monitor progress of all the activities specified in the program referred to in GCC Sub-Clause 18.2 (Program of Performance) above, and supply a progress report to the Project Manager every month. The progress report shall be in a form acceptable to the Project Manager and shall also indicate: (a) percentage completion achieved compared with the planned percentage completion for each activity; and (b) where any activity is behind the program, giving comments and likely consequences and stating the corrective action being taken. 18.4 Progress of Performance If at any time the Contractor's actual progress falls behind the program referred to in GCC Sub-Clause 18.2 (Program of Performance), or it becomes apparent that it will so fall behind, the Contractor shall, at the request of the Employer or the Project Manager, prepare and submit to the Project Manager a revised program, taking into account the prevailing circumstances, and shall notify the Project Manager of the steps being taken to expedite progress so as to attain Completion of the Facilities within the Time for Completion under GCC Sub-Clause 8.2 (Time for Commencement and Completion), any extension thereof entitled under GCC Sub-Clause 40.1 (Extension of Time for Completion), or any extended period as may otherwise be agreed upon between the Employer and the Contractor. 18.5 Work Procedures The Contract shall be executed in accordance with the Contract Documents and the procedures given in the section on Forms and Procedures of the Contract Documents. If agreed between the Employer and the Contractor, the Contractor may execute the Contract in accordance with its own standard project execution plans and procedures to the extent that they do not conflict with the provisions contained in the Contract.	
19. Subcontracting	19.1 Appendix 5 (List of Approved Subcontractors) to the Contract Agreement specifies major items of supply or services and a list of approved Subcontractors against each item, including vendors. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such list or any modification thereto to the Employer for its approval in sufficient time so as not to impede the progress of work on the Facilities. Such approval by the Employer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties or responsibilities under the Contract.	
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20. Design and Engineering	19.2	The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in GCC Sub-Clause 19.1.
	19.3	For items or parts of the Facilities not specified in Appendix 5 (List of Approved Subcontractors) to the Contract Agreement, the Contractor may employ such Subcontractors as it may select, at its discretion.
	20.1	Specifications and Drawings
	20.1.1	The Contractor shall execute the basic and detailed design and the engineering work in compliance with the provisions of the Contract, or where not so specified, in accordance with good engineering practice. The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Project Manager or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer.
	20.1.2	The Contractor shall be entitled to disclaim responsibility for any design, data, drawing, specification or other document, or any modification thereof provided or designated by or on behalf of the Employer, by giving a notice of such disclaimer to the Project Manager.
	20.2	Codes and Standards Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty-eight (28) days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by the Employer and shall be treated in accordance with GCC Clause 39 (Changes Originating from Contractor).
	20.3	Approval/Review of Technical Documents by Project Manager
	20.3.1	The Contractor shall prepare (or cause its Subcontractors to prepare) and furnish to the Project Manager the documents listed in Appendix 7 (List of Documents for Approval or Review) to the Contract Agreement for its approval or review as specified and as in accordance with the requirements of GCC Sub-Clause 18.2 (Program of Performance). Any part of the Facilities covered by or related to the documents to be approved by the Project Manager shall be executed only after the Project Manager's approval thereof.
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	GCC Sub-Clauses 20.3.2 through 20.3.7 shall apply to those documents requiring the Project Manager's approval, but not to those furnished to the Project Manager for its review only. 20.3.2 Within twenty one (21) days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Sub-Clause 20.3.1, the Project Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefor and the modifications that the Project Manager proposes. 20.3.3 The Project Manager shall not disapprove any document, except on the grounds that the document does not comply with some specified provision of the Contract or that it is contrary to good engineering practice. 20.3.4 If the Project Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Project Manager's approval in accordance with GCC Sub-Clause 20.3.2. If the Project Manager approves the document subject to modification(s), the Contractor shall make the required modification(s), and upon resubmission with the required modifications the document shall be deemed to have been approved. The procedure for submission of the documents by the Contractor and their approval by the Project Manager shall be discussed and finalised with the Contractor. 20.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Adjudicator for determination in accordance with GCC Sub-Clause 6.1 (Adjudicator) hereof. If such dispute or difference is referred to an Adjudicator, the Project Manager shall give instructions as to whether and if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Project Manager's instructions, provided that if the Adjudicator upholds the Contractor's view on the dispute and if the Employer has not given notice under GCC Sub-Clause 6.1.2 hereof, then the Contractor shall be reimbursed by the Employer for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Adjudicator shall decide, and the Time for Completion shall be extended accordingly.	
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	20.3.6 The Project Manager's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any subsequent failure results from modifications required by the Project Manager. 20.3.7 The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Project Manager an amended document and obtained the Project Manager's approval thereof, pursuant to the provisions of this GCC Sub-Clause 20.3. If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of GCC Clause 39 (Change in the Facilities) shall apply to such request.	
21. Procurement	21.1 Plant and Equipment Subject to GCC Sub-Clause 14.2, the Contractor shall manufacture or procure and transport all the Plant and Equipment in an expeditious and orderly manner to the Site. 21.2 Employer-Supplied Plant, Equipment, and Materials If Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement provides that the Employer shall furnish any specific items of machinery, equipment or materials to the Contractor, the following provisions shall apply: 21.2.1 The Employer shall, at its own risk and expense, transport each item to the place on or near the Site as agreed upon by the parties and make such item available to the Contractor at the time specified in the program furnished by the Contractor, pursuant to GCC Sub-Clause 18.2 (Program of Performance), unless otherwise mutually agreed. 21.2.2 Upon receipt of such item, the Contractor shall inspect the same visually and notify the Project Manager of any detected shortage, defect or default. The Employer shall immediately remedy any shortage, defect or default, or the Contractor shall, if practicable and possible, at the request of the Employer, remedy such shortage, defect or default at the Employer's cost and expense. After inspection, such item shall fall under the care, custody and control of the Contractor. The provision of this GCC Sub-Clause 21.2.2 shall apply to any item supplied to remedy any such shortage or default or to substitute for any defective item, or shall apply to defective items that have been repaired. 21.2.3 The foregoing responsibilities of the Contractor and its obligations of care, custody and control shall not relieve the Employer of liability for any undetected shortage, defect or default, nor place	
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	the Contractor under any liability for any such shortage, defect or default whether under GCC Clause 27 (Defect Liability) or under any other provision of Contract. 21.3 Transportation 21.3.1 The Contractor shall at its own risk and expense transport all the Plant and Equipment and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances. 21.3.2 Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the Plant and Equipment and the Contractor's Equipment. 21.3.3 Upon despatch of each shipment of the Plant and Equipment and the Contractor's Equipment, the Contractor shall notify the Employer by courier, post or by telefax followed by post confirmation of the description of the Plant and Equipment and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish the Employer with relevant shipping documents to be agreed upon between the parties. 21.3.4 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the Plant and Equipment and the Contractor's Equipment to the Site. The Employer shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the Plant and Equipment and the Contractor's Equipment to the Site. 21.4 Customs Clearance The Contractor shall, at its own expense, handle all imported Plant and Equipment including spares and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance, including liability for port charges etc., if any, subject to the Employer's obligations under GCC Sub-Clause 14.2, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Employer, the Employer shall take all necessary steps to comply with such laws or regulations. In the event of delays in customs clearance due to fault of the Employer, the Contractor shall be entitled to an extension in the Time for Completion, pursuant to GCC Clause 40.	
22. Installation	22.1 Setting Out/Supervision/Labor 22.1.1 Bench Mark: The Contractor shall be responsible for the true and proper setting-out of the Facilities in relation to bench marks,	
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	reference marks and lines provided to it in writing by or on behalf of the Employer. If, at any time during the progress of installation of the Facilities, any error shall appear in the position, level or alignment of the Facilities, the Contractor shall forthwith notify the Project Manager of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Project Manager. If such error is based on incorrect data provided in writing by or on behalf of the Employer, the expense of rectifying the same shall be borne by the Employer.	
22.1.2	Contractor's Supervision: The Contractor shall give or provide all necessary superintendence during the installation of the Facilities, and the Construction Manager or its deputy shall be constantly on the Site to provide full-time superintendence of the installation. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the work at hand.	
22.1.3	Labour:	
	(a) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills. (b) Unless otherwise provided in the Contract, the Contractor shall be responsible for the recruitment, transportation, accommodation and catering of all labor, local or expatriate, required for the execution of the Contract and for all payments in connection therewith. (c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labor and personnel to be employed on the Site into the country where the Site is located. (d) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor's personnel employed on the Contract at the Site to their various home countries. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, the Employer may provide the same to such	
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	personnel and recover the cost of doing so from the Contractor. (e) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors. (f) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious or other customs and all local laws and regulations pertaining to the employment of labor. 22.2 Contractor's Equipment 22.2.1 All Contractor's Equipment brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Project Manager's consent that such Contractor's Equipment is no longer required for the execution of the Contract. 22.2.2 Unless otherwise specified in the Contract, upon completion of the Facilities, the Contractor shall remove from the Site all Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon. 22.2.3 The Employer will, if requested, use its best endeavors to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor's Equipment imported by the Contractor for use in the execution of the Contract that is no longer required for the execution of the Contract. 22.3 Site Regulations and Safety The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Project Manager, proposed Site regulations for the Employer's approval, which approval shall not be unreasonably withheld. Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Facilities, gate control, sanitation, medical care, and fire prevention. 22.4 Opportunities for Other Contractors 22.4.1 The Contractor shall, upon written request from the Employer or the Project Manager, give all reasonable opportunities for carrying
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	out the work to any other contractors employed by the Employer on or near the Site.	
	22.4.2	If the Contractor, upon written request from the Employer or the Project Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, the Employer shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.
	22.4.3	The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Project Manager shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of the Employer in regard to their work.
	22.4.4	The Contractor shall notify the Project Manager promptly of any defects in the other Contractors' work that come to its notice, and that could affect the Contractor's work. The Project Manager shall determine the corrective measures, if any, required to rectify the situation after inspection of the Facilities. Decisions made by the Project Manager shall be binding on the Contractor.
	22.5	Emergency Work If, by reason of an emergency arising in connection with and during the execution of the Contract, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Facilities, the Contractor shall immediately carry out such work. If the Contractor is unable or unwilling to do such work immediately, the Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Facilities. In such event the Employer shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefor. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. Otherwise, the cost of such remedial work shall be borne by the Employer.
	22.6	Site Clearance 22.6.1 Site Clearance in Course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or
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		temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.	
	22.6.2	Clearance of Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site and Facilities clean and safe.	
	22.7	Watching and Lighting The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.	
	22.8	Work at Night and on Holidays	
	22.8.1	Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Project Manager, provided that provisions of this GCC Sub-Clause 22.8.1 shall not apply to any work which is customarily carried out by rotary or double-shifts.	
	22.8.2	Notwithstanding GCC Sub-Clauses 22.8.1 or 22.1.3, if and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Employer's consent thereto, the Employer shall not unreasonably withhold such consent.	
23.	Test and Inspection	23.1	The Contractor shall at its own expense carry out at the place of manufacture and/or on the Site all such tests and/or inspections of the Plant and Equipment and any part of the Facilities as are specified in the Contract.
		23.2	The Employer and the Project Manager or their designated representatives shall be entitled to attend the aforesaid test and/or inspection, provided that the Employer shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all traveling and boarding & lodging expenses.
		23.3	Whenever the Contractor is ready to carry out any such test and/or inspection, the Contractor shall give a reasonable advance notice of such test and/or inspection and of the place and time thereof to the Project Manager. The Contractor shall obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Employer and the Project Manager (or their designated representatives) to attend the test and/or inspection.
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	23.4 The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection. If the Employer or Project Manager (or their designated representatives) fails to attend the test and/or inspection, or if it is agreed between the parties that such persons shall not do so, then the Contractor may proceed with the test and/or inspection in the absence of such persons, and may provide the Project Manager with a certified report of the results thereof. 23.5 The Project Manager may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in the carrying out of such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impedes the progress of work on the Facilities and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected. 23.6 If any Plant and Equipment or any part of the Facilities fails to pass any test and/or inspection, the Contractor shall either rectify or replace such Plant and Equipment or part of the Facilities and shall repeat the test and/or inspection upon giving a notice under GCC Sub-Clause 23.3. 23.7 If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant and Equipment or part of the Facilities that cannot be settled between the parties within a reasonable period of time, it may be referred to the Adjudicator for determination in accordance with GCC Sub-Clause 6.1 (Adjudicator). 23.8 The Contractor shall afford the Employer and the Project Manager, at the Employer's expense, access at any reasonable time to any place where the Plant and Equipment are being manufactured or the Facilities are being installed, in order to inspect the progress and the manner of manufacture or installation, provided that the Project Manager shall give the Contractor a reasonable prior notice. 23.9 The Contractor agrees that neither the execution of a test and/or inspection of Plant and Equipment or any part of the Facilities, nor the attendance by the Employer or the Project Manager, nor the issue of any test certificate pursuant to GCC Sub-Clause 23.4, shall release the Contractor from any other responsibilities under the Contract. 23.10 No part of the Facilities or foundations shall be covered up on the Site without the Contractor carrying out any test and/or inspection required under the Contract. The Contractor shall give a reasonable notice to the Project Manager whenever any such part of the Facilities or foundations are ready or about to be ready for test and/or inspection; such test and/or inspection and notice thereof shall be subject to the requirements of the Contract.
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24. Commissioning and Completion of the Facilities	23.11 The Contractor shall uncover any part of the Facilities or foundations, or shall make openings in or through the same as the Project Manager may from time to time require at the Site, and shall reinstate and make good such part or parts. If any part of the Facilities or foundations have been covered up at the Site after compliance with the requirement of GCC Sub-Clause 23.10 and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by the Employer, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.	
	24.1 As soon as installation of the Facilities or any part thereof has, in the opinion of the Contractor, been completed as specified in the Technical Specifications, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Employer in writing. 24.2 Within seven (7) days after receipt of the notice from the Contractor under GCC Sub-Clause 24.1, the Employer shall supply the operating and maintenance personnel and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters as specified in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement, required for Precommissioning of the Facilities or any part thereof. 24.3 As soon as reasonably practicable after the operating and maintenance personnel have been supplied by the Employer and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters have been provided by the Employer, all as specified in Appendix 6 (Scope of Works and Supply by the Employer) to Contract Agreement and in accordance with GCC Sub-Clause 24.2, the Contractor shall commence Precommissioning of the Facilities or the relevant part thereof in preparation for Commissioning. 24.4 As soon as all works in respect of Precommissioning are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall commence Commissioning of the facilities. As soon as Commissioning is satisfactorily completed, the Contractor shall so notify the Project Manager in writing. 24.5 Commissioning of the Facilities or any part thereof shall be completed by the Contractor as per procedures detailed in the Technical Specifications. The Employer shall supply the operating and maintenance personnel and all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters as specified in Appendix-6 (Scope of Works and Supply by the Employer) to the Contract Agreement, required for	
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	Commissioning of the facilities. 24.6 The Project Manager shall, within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 24.4, either issue a Completion Certificate in the form specified in Section-VII (Forms and Procedures) of the bidding documents, stating that the Facilities or that part thereof have reached Completion as at the date of the Contractor's notice under GCC Sub-Clause 24.4, or notify the Contractor in writing of any defects and/or deficiencies. If the Project Manager notifies the Contractor of any defects and/or deficiencies, the Contractor shall then correct such defects and/or deficiencies, and shall repeat the procedure described in GCC Sub-Clause 24.4. If the Project Manager is satisfied that the Facilities or that part thereof have reached Completion, the Project Manager shall, within seven (7) days after receipt of the Contractor's repeated notice, issue a Completion Certificate stating that the Facilities or that part thereof have reached Completion as at the date of the Contractor's repeated notice. If the Project Manager is not so satisfied, then he shall notify the Contractor in writing of any defects and/or deficiencies within seven (7) days after receipt of the Contractor's repeated notice, and the above procedure shall be repeated. 24.7 If the Project Manager fails to issue the Completion Certificate and fails to inform the Contractor of any defects and/or deficiencies within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 24.4 or within seven (7) days after receipt of the Contractor's repeated notice under GCC Sub-Clause 24.6, or if the Employer makes use of the Facilities or part thereof, then the Facilities or that part thereof shall be deemed to have reached Completion as of the date of the Contractor's notice or repeated notice, or as of the Employer's use of the Facilities, as the case may be. 24.8 As soon as possible after Completion, the Contractor shall complete all outstanding minor items so that the Facilities are fully in accordance with the requirements of the Contract, failing which the Employer will undertake such completion and deduct the costs thereof from any monies owing to the Contractor. 24.9 Upon Completion, the Employer shall be responsible for the care and custody of the Facilities or the relevant part thereof, together with the risk of loss or damage thereto, and shall thereafter take over the Facilities or the relevant part thereof.
25. Guarantee Tests and Operational Acceptance	25.1 Guarantee Test 25.1.1 The Guarantee Test (and repeats thereof) shall be conducted by the Contractor after completion of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can
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	attain the Functional Guarantees specified in the Contract Documents. The Contractor's and Project Manager's personnel shall attend the Guarantee Test. The Employer shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test (and any repeats thereof). 25.1.2 If for reasons attributable to the employer, the Guarantee Test of the Facilities or the relevant part thereof cannot be successfully completed within the period from the date of Completion of the respective facility, as specified in the SCC or any other period agreed upon by the Employer and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Functional Guarantees, and GCC Sub-Clauses 28.2 and 28.3 shall not apply. 25.2 Operational Acceptance 25.2.1 Subject to GCC Sub-Clause 25.3 (Partial Acceptance) below, Operational Acceptance shall occur in respect of the Facilities or any part thereof when (a) the Guarantee Test has been successfully completed and the Functional Guarantees are met; or (b) the Guarantee Test has not been successfully completed or has not been carried out for reasons attributable to the employer within the period from the date of Completion specified in the SCC or any other agreed upon period as specified in GCC Sub-Clause 25.1.2 above, but successful Completion of the Facilities has been achieved; or (c) the Contractor has paid the liquidated damages specified in GCC Sub-Clause 28.3 hereof; and (d) any minor items mentioned in GCC Sub-Clause 24.8 hereof relevant to the Facilities or that part thereof have been completed. 25.2.2 At any time after any of the events set out in GCC Sub-Clause 25.2.1 have occurred, the Contractor may give a notice to the Project Manager requesting for issue of an Operational Acceptance Certificate in the form provided in the Bidding Documents or in another form acceptable to the Employer in respect of the Facilities or the part thereof specified in such notice as at the date of such notice. 25.2.3 The Project Manager shall, after consultation with the Employer, and within forty five (45) days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate.
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	25.2.4 If within forty five (45) days after receipt of the Contractor's notice, the Project Manager fails to issue the Operational Acceptance Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Project Manager has not issued the Operational Acceptance Certificate, the Facilities or the relevant part thereof shall be deemed to have been accepted as at the date of the Contractor's said notice. 25.3 Partial Acceptance 25.3.1 If the Contract specifies that Commissioning, completion and guarantee tests shall be carried out in respect of parts of the Facilities, the provisions relating to Commissioning, completion and the Guarantee Test shall apply to each such part of the Facilities individually, and the Operational Acceptance Certificate shall be issued accordingly for each such part of the Facilities. 25.3.2 If a part of the Facilities comprises facilities such as buildings, for which no Commissioning or Guarantee Test is required, then the Project Manager shall issue the Operational Acceptance Certificate for such facility when it attains Completion, provided that the Contractor shall thereafter complete any outstanding minor items that are listed in the Operational Acceptance Certificate. F. Guarantees and Liabilities	
26. Completion Time Guarantee	26.1 The Contractor guarantees that it shall attain Completion of the Facilities (or a part for which a separate time for completion is specified in the SCC) within the Time for Completion specified in the SCC pursuant to GCC Sub-Clause 8.2, or within such extended time to which the Contractor shall be entitled under GCC Clause 40 (Extension of Time for Completion) hereof. 26.2 If the Contractor fails to attain successful Completion of the Facilities or any part thereof within the Time for Completion or any extension thereof under GCC Clause 40 (Extension of Time for Completion), the Contractor shall pay to the Employer liquidated damages in the amount computed at the rates specified in the SCC. The aggregate amount of such liquidated damages shall in no event exceed the amount specified as "Maximum" in the SCC. Once the "Maximum" is reached, the Employer may consider termination of the Contract, pursuant to GCC Sub-Clause 42.2.2. Such payment shall completely satisfy the Contractor's obligation to attain Completion of the Facilities or the relevant part thereof within the Time for Completion or any extension thereof under GCC Clause 40 (Extension of Time for Completion). The Contractor shall have no further liability whatsoever to the Employer in respect thereof. However, the payment of liquidated damages shall not in any way relieve the Contractor from any of its obligations to complete the Facilities or	
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27.	Defect Liability	from any other obligations and liabilities of the Contractor under the Contract.			
		Save for liquidated damages payable under this GCC Sub-Clause 26.2, the failure by the Contractor to attain any milestone or other act, matter or thing by any date specified in Appendix 4 (Time Schedule) to the Contract Agreement and/or other program of work prepared pursuant to GCC Clause 18 (Program of Performance) shall not render the Contractor liable for any loss or damage thereby suffered by the Employer.			
		26.3 No bonus will be given for earlier completion of the facilities or part thereof.			
		27.1 The Contractor warrants that the Facilities or any part thereof shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed.			
		27.2 The Defect Liability Period shall be eighteen (18) months from the date of successful Completion of the Facilities (or any part thereof) or twelve (12) months from the date of Operational Acceptance of the Facilities (or any part thereof), whichever occurs first.			
		If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Contractor, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:			
		(a) improper operation or maintenance of the Facilities by the Employer			
		(b) operation of the Facilities outside specifications provided in the Contract			
		(c) normal wear and tear.			
		27.3 The Contractor's obligations under this GCC Clause 27 shall not apply to			
		(a) any materials that are supplied by the Employer under GCC Sub-Clause 21.2 (Employer-Supplied Plant, Equipment and Materials), are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein			
		(b) any designs, specifications or other data designed, supplied or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein			
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	(c) any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the Employer under GCC Sub-Clause 27.7. 27.4 The Employer shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect any such defect. 27.5 The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this GCC Clause 27. The Contractor may, with the consent of the Employer, remove from the Site any Plant and Equipment or any part of the Facilities that are defective, if the nature of the defect and/or any damage to the Facilities caused by the defect is such that repairs cannot be expeditiously carried out at the Site. 27.6 If the repair, replacement or making good is of such a nature that it may affect the efficiency of the Facilities or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests. If such part fails the tests, the Contractor shall carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests. The tests, in character, shall in any case be not inferior than what has already been agreed upon by the Employer and the Contractor for the original equipment/part of the Facilities. 27.7 If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than fifteen (15) days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due to the Contractor or claimed under the Performance Securities. 27.8 If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons. Upon correction of the defects in the Facilities or any part thereof by repair/replacement, such repair/replacement shall have the Defect Liability Period for a period of twelve (12) month from the time such
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28. Functional Guarantees	replacement/repair of the Facilities or any part thereof has been completed.
	27.8.1 At the end of the Defect Liability Period, the contractor liability ceases except for latent defects. The contractor's liability for latent defects warranty for the plant and equipment including spares shall be limited to a period of five (5) years from the end of Defect Liability Period of the respective plant and equipment including spares. For the purpose of this clause, the latent defects shall be the defects inherently lying within the material or arising out of design deficiency which do not manifest themselves during the Defect Liability Period as defined in this GCC clause 27, but later.
	27.9 Except as provided in GCC Clauses 27 and 33 (Loss of or Damage to Property / Accident or Injury to Workers/Indemnification), the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant and Equipment, design or engineering or work executed that appear after Completion of the Facilities or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal or willful action of the Contractor.
	27.10 In addition, the Contractor shall also provide an extended warranty for any such component of the Facilities and for the period of time as may be specified in the SCC. Such obligation shall be in addition to the defect liability specified under GCC Sub-Clause 27.2.
	28.1 The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Functional Guarantees as specified in Appendix-8 (Functional Guarantee) to the Contract Agreement under 'Functional Guarantees and Liquidated Damages', of Section-VI (Technical Specifications), subject to and upon the conditions therein specified.
	28.2 If, for reasons attributable to the Contractor, the guaranteed level of the Functional Guarantees parameters specified under 'Functional Guarantees and Liquidated Damages', of Section-VI (Technical Specification) are not met either in whole or in part, the Contractor shall, within the time period mentioned in the Technical Specification or as mutually agreed, at its cost and expense make such changes, modifications and/or additions to the Plant or any part thereof as may be necessary to meet such Guarantees. The Contractor shall notify the Employer upon completion of the necessary changes, modifications and/or additions, and shall seek the Employer's consent to repeat the Guarantee Test(s). If the guaranteed level of the specified Functional Guarantees parameters(s) are still not met but the parameters are achieved within the acceptable shortfall limit as specified under 'Functional Guarantees and Liquidated Damages', Part-A of Section-VI (Technical Specification), then the Employer will accept the equipment/ system/plant after levy of liquidated damages in accordance with the provisions specified under 'Functional Guarantees and Liquidated Damages', Part-A of Section-VI (Technical Specification). However, if the level of the specified Functional Guarantee
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	parameters, as demonstrated even during repeat of the Guarantee Test(s), are outside the acceptable shortfall limit as specified under 'Functional Guarantees and Liquidated Damages', Part-A of Section-VI (Technical Specification), the Employer may at its option, either (a) Reject the Equipment and recover the payments already made, or (b) Terminate the Contract pursuant to GCC Sub-Clause 42.2.2 and recover the payments already made, or (c) Accept the equipment/system/plant after levy of liquidated damages in accordance with the provisions specified under 'Functional Guarantees and Liquidated Damages', Part-A of Section-VI (Technical Specification). 28.3 In case the Employer exercises its option to accept the equipment after levy of liquidated damages, the payment of liquidated damages under GCC Sub-Clause 28.2, up to the limitation of liability specified under 'Functional Guarantees and Liquidated Damages', Part-A of Section-VI (Technical Specification), shall completely satisfy the Contractor's guarantees under GCC Sub-Clause 28.2 and the Contractor shall have no further liability whatsoever to the Employer in respect thereof. Upon the payment of such liquidated damages by the Contractor, the Project Manager shall issue the Operational Acceptance Certificate for the Facilities or any part thereof in respect of which the liquidated damages have been so paid. 29. Patent Indemnity 29.1 The Contractor shall, subject to the Employer's compliance with GCC Sub-Clause 29.2, indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Employer may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facilities by the Contractor or the use of the Facilities in the country where the Site is located; and (b) the sale of the products produced by the Facilities in any country. Such indemnity shall not cover any use of the Facilities or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract, any infringement resulting from the use of the Facilities or any part thereof, or any products produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract Agreement. 29.2 If any proceedings are brought or any claim is made against the Employer arising out of the matters referred to in GCC Sub-Clause 29.1, the Employer shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Employer's name conduct
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	such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim. The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing. 29.3 The Employer shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Employer.	
30. Limitation of Liability	30.1 Except in cases of criminal negligence or willful misconduct, (a) the Contractor shall not be liable to the Employer, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Employer and (b) the aggregate liability of the Contractor to the Employer, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to any obligation of the Contractor to indemnify the Employer with respect to patent infringement.	
	G. Risk Distribution	
31. Transfer of Ownership	31.1 Ownership of the Plant and Equipment (including spare parts) to be imported into the country where the Site is located shall be transferred to the Employer upon loading on to the mode of transport to be used to convey the Plant and Equipment (including spare parts) from the country of origin to that country and upon endorsement of the despatch documents in favour of the employer.	
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	31.2 Ownership of the Plant and Equipment (including spare parts) procured in the country where the Site is located shall be transferred to the Employer when the Plant and Equipment (including spare parts) are loaded on to the mode of transport to be used to convey the Plant and Equipment (including spare parts) from the works to the site and upon endorsement of the despatch documents in favour of the Employer. 31.3 Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors. 31.4 Ownership of any Plant and Equipment in excess of the requirements for the Facilities shall revert to the Contractor upon Completion of the Facilities or at such earlier time when the Employer and the Contractor agree that the Plant and Equipment in question are no longer required for the Facilities, provided quantity of any Plant and Equipment specifically stipulated in the Contract shall be the property of the Employer whether or not incorporated in the Facilities. 31.5 Notwithstanding the transfer of ownership of the Plant and Equipment, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor pursuant to GCC Clause 32 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant and Equipment are incorporated. 31.6 In case of two/three Contracts entered into between the Employer and the Contractor as per GCC Sub-Clause 3.6 or where the Employer hands over his equipment to the Contractor for executing the Contract, then the Contractor shall, at the time of taking delivery of the Equipment through Bill of Lading or other despatch documents, furnish Trust Receipt for Plant, Equipment and Materials and also execute an Indemnity Bond in favour of the Employer for keeping the equipment in safe custody and to utilise the same exclusively for the purpose of the said Contract. The Trust Receipt and Indemnity Bond shall be furnished as per proforma enclosed in Section VII (Forms and Procedures). The Employer shall also issue a separate Authorisation Letter to the Contractor to enable him to take physical delivery of plant, equipment and materials from the Employer as per proforma enclosed under Section-VII (Forms and Procedures).	
32. Care of Facilities	32.1 The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Completion of the Facilities pursuant to GCC Clause 24 (Commissioning and Completion of the Facilities) or, where the Contract provides for Completion of the Facilities in parts, until the date of Completion of the relevant part, and shall make good at its own cost any loss or damage that may occur to the Facilities or the relevant part thereof from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out pursuant to GCC Clause 27 (Defect Liability). Notwithstanding the foregoing, the Contractor shall not be	
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	liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Sub-Clauses 32.2 and 38.1. 32.2 If any loss or damage occurs to the Facilities or any part thereof or to the Contractor's temporary facilities by reason of (a) (insofar as they relate to the country where the Site is located) nuclear reaction, nuclear radiation, radioactive contamination, pressure wave caused by aircraft or other aerial objects, or any other occurrences that an experienced contractor could not reasonably foresee, or if reasonably foreseeable could not reasonably make provision for or insure against, insofar as such risks are not normally insurable in the insurance market and are mentioned in the general exclusions of the policy of insurance, including War Risks and Political Risks, taken out under GCC Clause 34 (Insurance) hereof (b) any use or occupation by the Employer or any third party (other than a Subcontractor) authorised by the Employer of any part of the Facilities (c) any use of or reliance upon any design, data or specification provided or designated by or on behalf of the Employer, or any such matter for which the Contractor has disclaimed responsibility herein, the Employer shall pay to the Contractor all sums payable in respect of the Facilities executed, notwithstanding that the same be lost, destroyed or damaged, and will pay to the Contractor the replacement value of all temporary facilities and all parts thereof lost, destroyed or damaged. If the Employer requests the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Contractor shall make good the same at the cost of the Employer in accordance with GCC Clause 39 (Change in the Facilities). If the Employer does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Employer shall either request a change in accordance with GCC Clause 39 (Change in the Facilities), excluding the performance of that part of the Facilities thereby lost, destroyed or damaged, or, where the loss or damage affects a substantial part of the Facilities, the Employer shall terminate the Contract pursuant to GCC Sub-Clause 42.1 (Termination for Employer's Convenience) hereof, except that the Contractor shall have no entitlement to profit under paragraph (e) of GCC Sub-Clause 42.1.3 in respect of any unexecuted Facilities as at the date of termination. 32.3 The Contractor shall be liable for any loss of or damage to any Contractor's Equipment, or any other property of the Contractor used or intended to be used for purposes of the Facilities, except (i) as mentioned in GCC Sub-Clause 32.2 (with respect to the Contractor's temporary facilities),
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33. Loss of or Damage to Property; Accident or Injury to workers; Indemnification		and (ii) where such loss or damage arises by reason of any of the matters specified in GCC Sub-Clauses 32.2(b) and (c) and 38.1.
	32.4	With respect to any loss or damage caused to the Facilities or any part thereof or to the Contractor's Equipment by reason of any of the matters specified in GCC Sub-Clause 38.1, the provisions of GCC Sub-Clause 38.3 shall apply.
	33.1	Subject to GCC Sub - Clause 33.3, the Contractor shall indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person or loss of or damage to any property (other than the Facilities whether accepted or not), arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers or agents, except any injury, death or property damage caused by the negligence of the Employer, its contractors, employees, officers or agents.
	33.2	If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability under GCC Sub-Clause 33.1, the Employer shall promptly give the Contractor a notice thereof and the Contractor shall at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim. The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
	33.3	The Employer shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from any liability for loss of or damage to property of the Employer, other than the Facilities not yet taken over, that is caused by fire, explosion or any other perils, in excess of the amount recoverable from insurances procured under GCC Clause 34 (Insurances), provided that such fire, explosion or other perils were not caused by any act or failure of the Contractor.
	33.4	The party entitled to the benefit of an indemnity under this GCC Clause 33 shall take all reasonable measures to mitigate any loss or damage which has occurred. If the party fails to take such measures, the other party's liabilities shall be correspondingly reduced.
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34. Insurance	34.1 To the extent specified in Appendix 3 (Insurance Requirements) to the Contract Agreement, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified in the said Appendix. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, who should not unreasonably withhold such approval. (a) Cargo Insurance During Transport Covering loss or damage occurring while in transit from the Contractor's or Subcontractor's works or stores until arrival at the Site, to the Plant and Equipment (including spare parts therefor) and to the Contractor's Equipment. (b) Installation All Risks Insurance Covering physical loss or damage to the Facilities at the Site, occurring prior to Completion of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period. (c) Third Party Liability Insurance Covering bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property occurring in connection with the supply and installation of the Facilities. (d) Automobile Liability Insurance Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the execution of the Contract. (e) Workers' Compensation In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed. (f) Employer's Liability In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed. (g) Other Insurances Such other insurances as may be specifically agreed upon by the parties hereto as listed in the said Appendix 3. 34.2 The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 34.1, except for the Third Party Liability, Workers' Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor		
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	pursuant to GCC Sub-Clause 34.1 except for the Cargo Insurance During Transport, Workers' Compensation and Employer's Liability Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies. 34.3 The Contractor shall, in accordance with the provisions of Appendix 3 (Insurance Requirements) to the Contract Agreement, deliver to the Employer certificates of insurance (or copies of the insurance policies) as evidence that the required policies are in full force and effect. The certificates shall provide that no less than twenty-one (21) days' notice shall be given to the Employer by insurers prior to cancellation or material modification of a policy. 34.4 The Contractor shall ensure that, where applicable, its Subcontractor(s) shall take out and maintain in effect adequate insurance policies for their personnel and vehicles and for work executed by them under the Contract, unless such Subcontractors are covered by the policies taken out by the Contractor. 34.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances which are specified in Appendix 3 (Insurance Requirements) to the Contract Agreement. 34.6 If the Contractor fails to take out and/or maintain in effect the insurances referred to in GCC Sub-Clause 34.1, the Employer may take out and maintain in effect any such insurances and may from time to time deduct from any amount due to the Contractor under the Contract any premium that the Employer shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If the Employer fails to take out and/or maintain in effect the insurances referred to in GCC 34.5, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due to the Employer under the Contract any premium that the Contractor shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Employer. If the Contractor fails to or is unable to take out and maintain in effect any such insurances, the Contractor shall nevertheless have no liability or responsibility towards the Employer, and the Contractor shall have full recourse against the Employer for any and all liabilities of the Employer herein. 34.7 Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies effected by it pursuant to this GCC Clause 34, and the monies payable by any insurers shall be paid to the Contractor as per the procedure outlined in GCC Sub-Clause 34.8 below. The Employer shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which the Employer's interest is involved, the Contractor shall not give any release or make any compromise with the insurer without the prior written consent of the Employer. With respect to insurance claims in which the Contractor's interest is involved,
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	the Employer shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor. 34.8 (i) Wherever total damages/loss of equipment/material would occur, the Contractor will be entitled to payment of all amounts received from the underwriters except the following amounts: (a) The amount paid to the Contractor under the Contract in respect of equipment/material damaged/lost, excluding the pro-rata initial advance but including the entire amount of escalation, if any, already paid to the Contractor. (b) Custom Duties, Excise duty and other taxes and duties which have already been paid by the Employer. In the event the claim money settled is less than the total of the amounts in a & b above, then the entire claim money settled will be retained by the Employer and the Contractor will forthwith pay the Employer the short fall amount between the claim money and the total of amounts as per a & b mentioned above. Subsequent payments, if any, due under the Contract shall be regulated by the relevant terms of payment. (ii) In case of partial damage to any equipment/material during any stage, upon rectification of the damaged equipment/material to the satisfaction of the Employer, the Contractor shall be paid to the extent of claims settled by the underwriters.	
35. Unforeseen Conditions	35.1 If, during the execution of the Contract, the Contractor shall encounter on the Site any physical conditions (other than climatic conditions) or artificial obstructions that could not have been reasonably foreseen prior to the date of the Contract Agreement by an experienced contractor on the basis of reasonable examination of the data relating to the Facilities (including any data as to boring tests) provided by the Employer, and on the basis of information that it could have obtained from a visual inspection of the Site (if access thereto was available) or other data readily available to it relating to the Facilities, and if the Contractor determines that it will in consequence of such conditions or obstructions incur additional cost and expense or require additional time to perform its obligations under the Contract that would not have been required if such physical conditions or artificial obstructions had not been encountered, the Contractor shall promptly, and before performing additional work or using additional Plant and Equipment or Contractor's Equipment, notify the Project Manager in writing of (a) the physical conditions or artificial obstructions on the Site that could not have been reasonably foreseen	
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	(b) the additional work and/or Plant and Equipment and/or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions (c) the extent of the anticipated delay (d) the additional cost and expense that the Contractor is likely to incur. On receiving any notice from the Contractor under this GCC Sub-Clause 35.1, the Project Manager shall promptly consult with the Employer and the Contractor and decide upon the actions to be taken to overcome the physical conditions or artificial obstructions encountered. Following such consultations, the Project Manager shall instruct the Contractor, with a copy to the Employer, of the actions to be taken. 35.2 Any reasonable additional cost and expense incurred by the Contractor in following the instructions from the Project Manager to overcome such physical conditions or artificial obstructions referred to in GCC Sub-Clause 35.1 shall be paid by the Employer to the Contractor as an addition to the Contract Price. 35.3 If the Contractor is delayed or impeded in the performance of the Contract because of any such physical conditions or artificial obstructions referred to in GCC Sub-Clause 35.1, the Time for Completion shall be extended in accordance with GCC Clause 40 (Extension of Time for Completion).	
36. Change in Laws and Regulations	36.1 If, after the date seven (7) days prior to the last date of Bid submission, in the country where the Site is located, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. However, these adjustments would be restricted to direct transactions between the Employer and the Contractor/assignee of Foreign Contractor (if applicable). These adjustments shall not be applicable on procurement of raw materials, intermediary components etc. by the Contractor/assignee of foreign contractor and shall also not be applicable on the bought out items despatched directly from sub-vendor's works to site. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with Appendix 2 to the Contract Agreement. Further, no adjustment of the Contract Price and/or payment or reimbursement of taxes, duties or levies shall be made on account of variation in or withdrawal of Deemed Export benefits.	
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37. Force Majeure	37.1 "Force Majeure" shall mean any event beyond the reasonable control of the Employer or of the Contractor, as the case may be, and which is unavoidable notwithstanding the reasonable care of the party affected. 37.2 If either party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within fourteen (14) days after the occurrence of such event. 37.3 The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered or delayed. The Time for Completion shall be extended in accordance with GCC Clause 40 (Extension of Time for Completion). 37.4 The party or parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either party's right to terminate the Contract under GCC Sub-Clauses 37.6 and 38.5. 37.5 Delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall not (a) constitute a default or breach of the Contract (b) (subject to GCC Sub-Clauses 32.2, 38.3 and 38.4) give rise to any claim for damages or additional cost or expense occasioned thereby if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure. 37.6 If the performance of the Contract is substantially prevented, hindered or delayed for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of one or more events of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which the dispute shall be resolved in accordance with GCC Clause 6. 37.7 Notwithstanding GCC Sub-Clause 37.5, Force Majeure shall not apply to any obligation of the Employer to make payments to the Contractor herein.	
38. War Risks	38.1 "War Risks" shall mean any of the following events occurring or existing in or near the country (or countries) where the Site is located: (a) war, hostilities or warlike operations (whether a state of war is declared or not), invasion, act of foreign enemy and civil war	
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	(b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion and terrorist acts, and (c) any explosion or impact of any mine, bomb, shell, grenade or other projectile, missile, munitions or explosive of war. 38.2 Notwithstanding anything contained in the Contract, the Contractor shall have no liability whatsoever for or with respect to (a) destruction of or damage to Facilities, Plant & Equipment, or any part thereof (b) destruction of or damage to property of the Employer or any third party (c) injury or loss of life if such destruction, damage, injury or loss of life is caused by any War Risks, and the Employer shall indemnify and hold the Contractor harmless from and against any and all claims, liabilities, actions, lawsuits, damages, costs, charges or expenses arising in consequence of or in connection with the same. 38.3 If the Facilities or any Plant and Equipment or Contractor's Equipment or any other property of the Contractor used or intended to be used for the purposes of the Facilities shall sustain destruction or damage by reason of any War Risks, the Employer shall pay the Contractor for (a) any part of the Facilities or the Plant and Equipment so destroyed or damaged (to the extent not already paid for by the Employer) (b) replacing or making good any Contractor's Equipment or other property of the Contractor so destroyed or damaged so far as may be required by the Employer, and as may be necessary for completion of the Facilities, (c) replacing or making good any such destruction or damage to the Facilities or the Plant and Equipment or any part thereof. If the Employer does not require the Contractor to replace or make good any such destruction or damage to the Facilities, the Employer shall either request a change in accordance with GCC Clause 39 (Change in the Facilities), excluding the performance of that part of the Facilities thereby destroyed or damaged or, where the loss, destruction or damage affects a substantial part of the Facilities, shall terminate the Contract, pursuant to GCC Sub-Clause 42.1 (Termination for Employer's Convenience). 38.4 Notwithstanding anything contained in the Contract, the Employer shall pay the Contractor for any increased costs or incidentals to the
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	execution of the Contract that are in any way attributable to, consequent on, resulting from, or in any way connected with any War Risks, provided that the Contractor shall as soon as practicable notify the Employer in writing of any such increased cost. 38.5 If during the performance of the Contract any War Risks shall occur that financially or otherwise materially affect the execution of the Contract by the Contractor, the Contractor shall use its reasonable efforts to execute the Contract with due and proper consideration given to the safety of its and its Subcontractors' personnel engaged in the work on the Facilities, provided, however, that if the execution of the work on the Facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of any War Risks, the parties will attempt to develop a mutually satisfactory solution, failing which the dispute will be resolved in accordance with GCC Clause 6. 38.6 In the event of termination pursuant to GCC Sub-Clauses 38.3, the rights and obligations of the Employer and the Contractor shall be as specified in GCC Sub-Clauses 42.1.2 and 42.1.3, except that the Contractor shall have no entitlement to profit under paragraph (e) of GCC Sub-Clause 42.1.3 in respect of any unexecuted Facilities as of the date of termination. H. Change in Contract Elements	
39. Change in the Facilities	39.1 Introducing a Change 39.1.1 The Employer shall have the right to propose, and subsequently require, that the Project Manager order the Contractor from time to time during the performance of the Contract to make any change, modification, addition or deletion to, in or from the Facilities (hereinafter called "Change"), provided that such Change falls within the general scope of the Facilities and does not constitute unrelated work and that it is technically practicable, taking into account both the state of advancement of the Facilities and the technical compatibility of the Change envisaged with the nature of the Facilities as specified in the Contract . 39.1.2 The Contractor may from time to time during its performance of the Contract propose to the Employer (with a copy to the Project Manager) any Change that the Contractor considers necessary or desirable to improve the quality, efficiency or safety of the Facilities. The Employer may at its discretion approve or reject any Change proposed by the Contractor. 39.1.3 Notwithstanding GCC Sub-Clauses 39.1.1 and 39.1.2, no change made necessary because of any default of the Contractor in the performance of its obligations under the Contract shall be deemed to be a Change, and such change shall not result in any adjustment of the Contract Price or the Time for Completion.	
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	39.1.4 The procedure on how to proceed with and execute Changes is specified in GCC Sub-Clauses 39.2 and 39.3.
	39.2 Changes Originating from Employer
	39.2.1 If the Employer proposes a Change pursuant to GCC Sub-Clause 39.1.1, it shall send to the Contractor a "Request for Change Proposal," requiring the Contractor to prepare and furnish to the Project Manager as soon as reasonably practicable a "Change Proposal," which shall include the following:
	(a) brief description of the Change (b) effect on the Time for Completion (c) estimated cost of the Change (d) effect on Functional Guarantees (if any) (e) effect on any other provisions of the Contract.
	39.2.2 The pricing of any Change shall, as far as practicable, be calculated in accordance with the rates and prices included in the Contract. If the rates and prices of any change are not available in the Contract, the parties thereto shall agree on specific rates for the valuation of the Change.
	39.2.3 If before or during the preparation of the Change Proposal it becomes apparent that the aggregate effect of compliance therewith and with all other Change Orders that have already become binding upon the Contractor under this GCC Clause 39 would be to increase or decrease the Contract Price as originally set forth in Article 2 (Contract Price) of the Contract Agreement by more than fifteen percent (15%), the Contractor may give a written notice of objection thereto prior to furnishing the Change Proposal as aforesaid. If the Employer accepts the Contractor's objection, the Employer and the Contractor shall agree on specific rates for valuation of the change.
	39.2.4 Upon receipt of the Change Proposal, the Employer and the Contractor shall mutually agree upon all matters therein contained including agreement on rates if such rates are not available in the Contract or if the limit of 15% set forth in Clause 39.2.3 has been exceeded. Within fourteen (14) days after such agreement, the Employer shall, if it intends to proceed with the Change, issue the Contractor with a Change Order.
	If the Employer is unable to reach a decision within fourteen (14) days, it shall notify the Contractor with details of when the Contractor can expect a decision.
	If the Employer decides not to proceed with the Change for whatever reason, it shall, within the said period of fourteen (14) days, notify the Contractor accordingly.
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	39.2.5 If the Employer and the Contractor cannot reach agreement on the price for the Change, an equitable adjustment to the Time for Completion, or any other matters identified in the Change Proposal, the Employer may nevertheless instruct the Contractor to proceed with the Change by issue of a "Pending Agreement Change Order." Upon receipt of a Pending Agreement Change Order, the Contractor shall immediately proceed with effecting the Changes covered by such Order. The parties shall thereafter attempt to reach agreement on the outstanding issues under the Change Proposal. If the parties cannot reach agreement within sixty (60) days from the date of issue of the Pending Agreement Change Order, then the matter may be referred to the Adjudicator in accordance with the provisions of GCC Sub-Clause 6.1 (Adjudicator). 39.3 Changes Originating from Contractor 39.3.1 If the Contractor proposes a Change pursuant to GCC Sub-Clause 39.1.2, the Contractor shall submit to the Project Manager a written "Application for Change Proposal," giving reasons for the proposed Change and including the information specified in GCC Sub-Clause 39.2.1. Upon receipt of the Application for Change Proposal, the parties shall follow the procedures outlined in GCC Sub-Clauses 39.2.4 and 39.2.5		
40. Extension of Time for Completion	40.1 The Time(s) for Completion specified in the SCC shall be extended, if the Contractor is delayed or impeded in the performance of any of its obligations under the Contract by reason of any of the following: (a) any Change in the Facilities as provided in GCC Clause 39 (Change in the Facilities) (b) any occurrence of Force Majeure as provided in GCC Clause 37 (Force Majeure), unforeseen conditions as provided in GCC Clause 35 (Unforeseen Conditions), or other occurrence of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Sub-Clause 32.2 (c) any suspension order given by the Employer under GCC Clause 41 (Suspension) hereof or reduction in the rate of progress pursuant to GCC Sub-Clause 41.2 or (d) any changes in laws and regulations as provided in GCC Clause 36 (Change in Laws and Regulations) or (e) any default or breach of the Contract by the Employer, specifically including failure to supply the items listed in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement,		
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	or any activity, act or omission of any other contractors employed by the Employer or (f) any other matter specifically mentioned in the Contract; by such period as shall be fair and reasonable in all the circumstances and as shall fairly reflect the delay or impediment sustained by the Contractor. 40.2 Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Project Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, the Employer and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept the Employer's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to the Adjudicator, pursuant to GCC Sub-Clause 6.1 (Adjudicator). 40.3 The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract. 41. Suspension 41.1 The Employer/ Project Manager may, by notice to the Contractor, order the Contractor to suspend performance of any or all of its obligations under the Contract. Such notice shall specify the obligation of which performance is to be suspended, the effective date of the suspension and the reasons therefor. The Contractor shall thereupon suspend performance of such obligation (except those obligations necessary for the care or preservation of the Facilities) until ordered in writing to resume such performance by the Project Manager/ Employer. If, by virtue of a suspension order given by the Project Manager/Employer, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than ninety (90) days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Project Manager requiring that the Employer shall, within twenty-eight (28) days of receipt of the notice, order the resumption of such performance or request and subsequently order a change in the facilities in accordance with GCC Clause 39 (Change in the Facilities), excluding the performance of the suspended obligations from the Contract. If the Employer fails to do so within such period, the Contractor may, by a further notice to the Project Manager, elect to treat the suspension, where it affects only a part of the Facilities, as a deletion of such part of the facilities in accordance with GCC Clause 39 (Change in the Facilities) or, where it affects the whole of the Facilities, as termination of the
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	Contract under GCC Sub-Clause 42.1 (Termination for Employer's Convenience). 41.2 If (a) the Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice or (b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas in accordance with GCC Sub-Clause 10.2, or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities; then the Contractor may by fourteen (14) days' notice to the Employer suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress. 41.3 If the Contractor's performance of its obligations is suspended or the rate of progress is reduced pursuant to this GCC Clause 41, then the Time for Completion shall be extended in accordance with GCC Sub-Clause 40.1, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction shall be paid by the Employer to the Contractor in addition to the Contract Price, except in the case of suspension order or reduction in the rate of progress by reason of the Contractor's default or breach of the Contract. 41.4 During the period of suspension, the Contractor shall not remove from the Site any Plant and Equipment, any part of the Facilities or any Contractor's Equipment, without the prior written consent of the Employer.	
42. Termination	42.1 Termination for Employer's Convenience 42.1.1 The Employer may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers to this GCC Sub-Clause 42.1. 42.1.2 Upon receipt of the notice of termination under GCC Sub-Clause 42.1.1, the Contractor shall either immediately or upon the date specified in the notice of termination	
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	(d) costs incurred by the Contractor in protecting the Facilities and leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Sub-Clause 42.1.2 (e) the cost of satisfying all other obligations, commitments and claims that the Contractor may in good faith have undertaken with third parties in connection with the Contract and that are not covered by paragraphs (a) through (d) above. 42.2 Termination for Contractor's Default 42.2.1 The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefor to the Contractor, referring to this GCC Sub-Clause 42.2: (a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Contractor takes or suffers any other analogous action in consequence of debt (b) if the Contractor assigns or transfers the Contract or any right or interest therein in violation of the provision of GCC Clause 43 (Assignment). (c) if the Contractor, in the judgement of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract. For the purpose of this Sub-Clause : "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution. "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.
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	42.2.2 42.2.3	If the Contractor (a) has abandoned or repudiated the Contract (b) has without valid reason failed to commence work on the Facilities promptly or has suspended (other than pursuant to GCC Sub-Clause 41.2) the progress of Contract performance for more than twenty-eight (28) days after receiving a written instruction from the Employer to proceed (c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause (d) refuses or is unable to provide sufficient materials, services or labor to execute and complete the Facilities in the manner specified in the program furnished under GCC Clause 18 (Program of Performance) at rates of progress that give reasonable assurance to the Employer that the Contractor can attain Completion of the Facilities by the Time for Completion as extended then the Employer may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within fourteen (14) days of its receipt of such notice, then the Employer may terminate the Contract forthwith by giving a notice of termination to the Contractor that refers to this GCC Sub-Clause 42.2. Upon receipt of the notice of termination under GCC Sub-Clauses 42.2.1 or 42.2.2, the Contractor shall, either immediately or upon such date as is specified in the notice of termination, (a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition (b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below (c) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination (d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Works and to the Plant and Equipment as at the date of termination, and,
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	as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors (e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities. 42.2.4 The Employer may enter upon the Site, expel the Contractor, and complete the Facilities itself or by employing any third party. The Employer may, to the exclusion of any right of the Contractor over the same, take over and use with the payment of a fair rental rate to the Contractor, with all the maintenance costs to the account of the Employer and with an indemnification by the Employer for all liability including damage or injury to persons arising out of the Employer's use of such equipment, any Contractor's Equipment owned by the Contractor and on the Site in connection with the Facilities for such reasonable period as the Employer considers expedient for the supply and installation of the Facilities. Upon completion of the Facilities or at such earlier date as the Employer thinks appropriate, the Employer shall give notice to the Contractor that such Contractor's Equipment will be returned to the Contractor at or near the Site and shall return such Contractor's Equipment to the Contractor in accordance with such notice. The Contractor shall thereafter without delay and at its cost remove or arrange removal of the same from the Site. 42.2.5 Subject to GCC Sub-Clause 42.2.6, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as at the date of termination, the value of any unused or partially used Plant and Equipment on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Sub-Clause 42.2.3. Any sums due to the Employer from the Contractor accruing prior to the date of termination shall be deducted from the amount to be paid to the Contractor under this Contract. 42.2.6 If the Employer completes the Facilities, the cost of completing the Facilities by the Employer shall be determined. If the sum that the Contractor is entitled to be paid, pursuant to GCC Sub-Clause 42.2.5, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price, the Contractor shall be liable for such excess. If such excess is greater than the sums due to the Contractor under GCC Sub-Clause 42.2.5, the Contractor shall pay the balance to the Employer, and if such excess is less than the	
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2	STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - IV (GCC)	PAGE 60 OF 63

Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
	sums due to the Contractor under GCC Sub-Clause 42.2.5, the Employer shall pay the balance to the Contractor. The Employer and the Contractor shall agree, in writing, on the computation described above and the manner in which any sums shall be paid. 42.3 Termination by Contractor 42.3.1 If (a) the Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to Appendix 1 (Terms and Procedures of Payment) of the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice, or (b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities which the Employer is required to obtain as per provision of the Contract or as per relevant applicable laws of the country, then the Contractor may give a notice to the Employer thereof, and if the Employer has failed to pay the outstanding sum, to approve the invoice or supporting documents, to give its reasons for withholding such approval, or to remedy the breach within twenty-eight (28) days of such notice, or if the Contractor is still unable to carry out any of its obligations under the Contract for any reason attributable to the Employer within twenty-eight (28) days of the said notice, the Contractor may by a further notice to the Employer referring to this GCC Sub-Clause 42.3.1, forthwith terminate the Contract. 42.3.2 The Contractor may terminate the Contract forthwith by giving a notice to the Employer to that effect, referring to this GCC Sub-Clause 42.3.2, if the Employer becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, being a corporation, if a resolution is passed or	
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2	STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - IV (GCC)	PAGE 61 OF 63

Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
	order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Employer takes or suffers any other analogous action in consequence of debt.	
42.3.3	If the Contract is terminated under GCC Sub-Clauses 42.3.1 or 42.3.2, then the Contractor shall immediately (a) cease all further work, except for such work as may be necessary for the purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition (b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d)(ii) (c) remove all Contractor's Equipment from the Site and repatriate the Contractor's and its Subcontractor's personnel from the Site (d) In addition, the Contractor, subject to the payment specified in GCC Sub-Clause 42.3.4, shall (i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination (ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors (iii) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities.	
42.3.4	If the Contract is terminated under GCC Sub-Clauses 42.3.1 or 42.3.2, the Employer shall pay to the Contractor all payments specified in GCC Sub-Clause 42.1.3, and reasonable compensation for all loss or damage sustained by the Contractor arising out of, in connection with or in consequence of such termination.	
42.3.5	Termination by the Contractor pursuant to this GCC Sub-Clause 42.3 is without prejudice to any other rights or remedies of the Contractor that may be exercised in lieu of or in addition to rights conferred by GCC Sub-Clause 42.3.	
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		PAGE 62 OF 63

Clause No.	GENERAL CONDITIONS OF CONTRACT (GCC)	
	42.4 In this GCC Clause 42, the expression "Facilities executed" shall include all work executed, Installation Services provided, any or all Plant and Equipment acquired (or subject to a legally binding obligation to purchase) by the Contractor and used or intended to be used for the purpose of the Facilities, up to and including the date of termination. 42.5 In this GCC Clause 42, in calculating any monies due from the Employer to the Contractor, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any advance payment paid pursuant to Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement.	
43.	Assignment	43.1 The Contractor shall not, without the express prior written consent of the Employer, assign to any third party the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder, except that the Contractor shall be entitled to assign either absolutely or by way of charge any monies due and payable to it or that may become due and payable to it under the Contract.
BONGAIGAON THERMAL POWER PROJECT (3x250 MW) BID DOCUMENT NO. CS-4610-101-2		STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE SECTION - IV (GCC)
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SECTION - IV

GENERAL CONDITIONS OF CONTRACT (GCC)

GENERAL CONDITIONS OF CONTRACT (GCC)		
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3.	Interpretation	4
4.	Notices	7
5.	Governing Law	7
6.	Settlement of Disputes	8
B.	Subject Matter of Contract	
7.	Scope of Facilities	10
8.	Time for Commencement and Completion	14
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**STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE FOR
BONGAIGAON THERMAL POWER PROJECT, (3 X 250 MW)
BID DOCUMENT NO. CS-4610-101-2**

Bidder's Name & Address :

To
Contract Services (Thermal-I),
NTPC Ltd.,
NOIDA - 201301

SCHEDULE OF RATES AND PRICES

Schedule No. 1 : Plant and Equipment including Type Test charges and Mandatory Spares to be supplied from Abroad

Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

(I) **MAIN EQUIPMENT**

(A) **Steam Generator (S.G.) and
Auxiliaries**

1. Boiler Main

(i) S.G. Pressure Parts

(a) Superheater

(b) Economiser

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(c) Water Wall Tubes						
	(d) Drum and its internals						
	(e) Reheaters						
	(ii) Attemperator system including all piping, valves and fittings						
	(iii) S.G. Structure including all platforms, gratings, handrails, stairs, walkways, ladders, complete with all auxiliary structures, interconnections, corrosion protection, foundation bolts etc.						
2.	Soot Blowing System						
3.	H.P. Chemical dosing system						
4.	Coal Preparation and Firing System						
	(i) RC Feeders with drives						
	(ii) Pulverisers with motor						
	(iii) PA Fans with motor						
	(iv) PF pipes						

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(v) Coal burners						
	(vi) Seal air fans with motor						
	(vii) Coal sampling system						
	(viii) Coal valves in PF line						
5.	Air Preheater with drives						
6.	Fuel Oil pressurising and Firing System						
	(i) Pumps with motors						
	(ii) Heaters						
	(iii) Rest including piping, valves, strainers, burners etc.						
7.	Draft Plant						
	(i) ID fan with motors						
	(ii) FD fan with motors						
	(iii) GR fan with motors (if applicable)						

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(iv) Rest including lube oil system						
8.	All ducting and dampers						
9.	All steam generator integral piping & valves						
10.	Refractories, insulation & cladding						
11.	Special Tools & Tackles						
12.	Blowdown tanks, SCAPH drain tanks & FO system condensate collection tank						
	(a) CBD, IBD etc. for Drum type boiler						
	(b) Atmospheric flash tank etc. for Drum through type boiler						
13.	Auxiliary steam pressure reducing & Desuperheating station						
14.	Electrical						
	(a) LT Switchgear / MCC, DC starter boxes						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(b) Other Electrical equipment not covered above						
15.	Elevators for steam generator						
16.	Elevators for ESP/VFD control room						
Sub Total of Item (I) (A)							
(B)	FGD system including all the associated auxiliaries, equipment etc.						
Sub Total of Item (I) (B)							
(C)	Auxiliary boiler with its associated auxiliaries						
Sub Total of Item (I) (C)							

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
(D)	Electrostatic Precipitator including structures, platforms, walkways, stairs, ladders, associated electrical systems etc.						
Sub Total of Item (I) (D)							
(E)	POWER CYCLE PIPING						
	1. Boiler External Piping System						
	(i) Piping, fittings & specialities						
	(ii) Valves						
	(iii) Hangers & supports						
	(iv) Insulation & cladding						
	(v) Any other item not covered above (Bidder to furnish list)						
(F)	Equipments for Oxygenated Treatment						
(G)	LP Dosing System						
(H)	Equipment Cooling Water System						
(I)	Elevators & Cranes						
(J)	Mill Reject Handling System						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
(K)	Air Compressors and Air Drying Plant						
(L)	Plant Performance Analysis, Diagnosis & Optimisation software system						
Sub Total of Item (I) (E to L)							
(M)	CONTROL & INSTRUMENTATION						
	(a) SG C&I System including BMS, SADC etc.						
	(b) Man Machine Interface System						
	(c) Balance C&I items in Bidder's Scope including Coal Feeders Control System, Electromatic Safety Valves, Furnace Temperature probes etc.						
	(d) Accoustic Pyrometers						
	(e) Furnance & Flame Viewing system						
	(f) Other SG-C&I Systems						
	(g) C&I for Plant Auxiliary Packages						
Sub Total of Item (I) (M)							
TOTAL OF ITEM (I) MAIN EQUIPMENT							

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

II. MANDATORY SPARES**1.00.00 STEAM GENERATOR & AUXILIARIES****1.00.00 PRESSURE PARTS****(A) Economiser**

1.	Straight Tube	600 Mtr. total for each size, type, thickness & material
2.	Coil end bends	80 Nos. of each size, type, thick- ness, radius & material.

(B) Water Wall

1.	Straight tube/Spiral tube	300 m total qty. for each type, thickness, size and material.
2.	Bends for Burner elevation	16 Nos. for each size, type, thick- ness, radius and material

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	3.	Screen water wall tube (if applicable)	100m including all types, size & material				
	(C) Low Temperature Super Heater (LTSH)						
	1.	Straight tube of 8-10 m length	600 mtr. total for each size, thickness, types & material				
	2.	Bends	80 Nos. of each size, type, thick- ness, radius and material.				
	(D) Intermediate Temperature Superheater (ITSH)/Platen SuperHeater						
	1.	Straight tube of 8-10 m length	200 m of each size, thickness, type & material				
	2.	Bends	20 nos. of each size, thickness, radius, type and material				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	3.	Male & Female couplings spacers	2 Sets**				
	4.	Dissimilar joint spot pcs.	50 Nos.				
	(E) High Temperature Superheater (HTSH) / Final Superheater						
	1.	Straight tube of 8-10 m length	150 mtr. of each size, thickness, type & material				
	2.	Bends	15 nos. of each size, thickness, type, radius & material				
	3.	Male & Female couplings spacers	2 sets**				
	4.	Dissimilar joint spot pcs.	50 Nos.				
	(F) Reheater						
	1.	Straight tube of 8-10 m length	200 metre each of size thickness, type & material				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	2.	Bends	15 Nos. of each size, thickness, type, radius & material				
	3.	Male & Female couplings spacer	2 sets**				
	4.	Dissimilar joint spot pcs.	50 Nos.				
1.00.01	Spares for Header						
	(A) Water wall Header						
	(I)	Hand hole plate	2 nos.				
	(ii)	Yoke plate with fasteners	2 sets*				
	(B) Spares for Superheater Header						
	(i)	Radiographic plug	4 nos.				
	(C) Spares for Reheater Header						
	(i)	Hand hole plate assembly	2 nos. of each type				
	(ii)	Radiographic plug	4 nos.				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.00.02	Superheater / Reheater Attemperation System						
	1. Desuperheater liner		2 sets of each type				
1.00.03	Steam Drum (For Drum Type Boiler)						
	1. Manhole gasket for Drum		6 nos.				
	2. Local water level gauge class assembly		1 set**				
	3. Spares for direct water level gauge (Repair kit for above such as port assembly, glass strip lamps spring cones, gaskets etc.)		1 set **				
	4. Spares for remote level indicator (Repair kit such as seal ring bull deflector plate, gasket, diaphragm etc.)		1 set **				
	5. Spare isolating valve assembly for above gauge glass		1 set **				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.00.04	Steam Generator water circulation pump (as applicable)						
	1. Motor stator winding		Nil				
	2. Journal bearing		1 set *				
	3. Thrust bearing		1 set *				
	4. Casing wear rings		2 sets *				
	5. Impeller wear rings		2 sets *				
	6. Set of gaskets		2 sets * (all gaskets including heat exchanger)				
	7. Set of 'O' rings		3 sets *				
	8. Gland packings		3 sets *				
	9. Motor heat exchanger		1 set *				
	10. Thermocouples		1 set *				
	11. Temp. switches		1 set *				
	12. Pressure switches		1 set *				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

13. Flow switch

1 set *

14. Transmitters

1 no. of each
type

* One set means one complete replacement
of one equipment (for all above clause)

** On set means for one steam generator
unit (for all above clauses)

1.01.00 Fans**1.01.01 ID Fans (Radial)**

1 Impeller liners

1 set

2 Casing liners

1 set

3 Motor bearings

2 sets

4 Fan bearings

2 sets

5 Seals, 'O' rings Oil rings
for all the Fan bearings.

4 sets

6 Lube Oil System

a) Pump assembly

2 nos.

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	b) Motor		2 nos.				
	c) Pressure regulator		2 nos.				
	d) Filters		4 nos.				
	e) Coupling between oil pump & motor		2 nos.				
	f) IGV		1 set				
1.01.02	FD Fans						
1	Fan bearings		2 sets				
2	Motor Bearings		2 sets				
3	Fan Blades		2 sets				
4	Spares for blade bearing Assembly						
	a) Bearings		2 sets				
	b) 'O' rings		2 sets				
	c) Bushes		2 sets				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	d)	Metallic rings	2 sets				
	e)	Intermediate piece (if applicable)	2 sets				
5	Lube Oil system						
	a)	Pump assembly	2 nos.				
	b)	Motor	2 nos.				
	c)	Pressure regulator	2 nos.				
	d)	Filters	4 nos.				
	e)	Coupling between oil pump & motor	2 nos.				
	f)	Couplings between fan & motor	1 nos.				
	g)	Hydraulic servomotor	2 nos.				
1.01.03	PA Fans						
	1.	Fan Bearings	2 sets				
	2.	Motor Bearings	2 sets				
	3.	Coupling between fan & motor	2 nos.				

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	4. Fan blades		2 sets				
	5. Spares for blades brg. Assembly						
	a) Bushes		2 sets				
	b) Bearings		2 sets				
	c) 'O' rings		2 sets				
	d) Metallic rings		2 sets				
	e) Intermediate piece(if applicable)		2 sets				
	6. Lube Oil System						
	a) Pump assembly		2 nos.				
	b) Motor		2 nos.				
	c) Pressure regulator		2 nos.				
	d) Filters		4 nos.				
	e) Pump & motor coupling		2 nos.				
	7. Hydraulic Servomotor		2 nos.				

Note : In Clause 1.01.01, 1.01.02 & 1.01.03 above, one set means one Complete replacement of one fan

SCHEDULE - 1

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

1.02.00 Coal Pulverizers

1.02.01 Grinding elements

(a) Rollers/tyres/grinding balls. 4 sets

(b) Bull ring segments/ bowl / rings 4 sets

Note : One set of grinding element at (a) & (b) above is defined as under :

1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 XN)/GWL rounded off to nearest higher whole number).

Where :

GWL = Guaranteed wear life of grinding element (a) & (b) as offered by the bidder.

N = Number of mills installed for one Steam generator unit.

1.02.02 Gear box internals (except bearings & seals) 4 sets *

1.02.03 Bearings 2 sets *

1.02.04 Seals & rings 2 sets *

1.02.05 Mill motor Bearings 2 sets *

1.02.06 Liners with brackets & fasteners 3 sets *

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.02.07	Discharge valve assembly		3 sets *				
1.02.08	Multiport outlet & liners		4 sets *				
1.02.09	Mill main shaft/yoke		1 no.				
1.02.10	Journal & Spring		9 nos.				
1.02.11	Hyd. Loading cylinder		2 nos.				
1.02.12	Filter Cartridges		4 nos.				
1.02.13	Actuators (complete)		1 no. of each type				
1.02.14	Actuator spare kits		1 set of each type *				
1.02.15	Mill Bottom		2 nos.				
1.02.16	Bowl hub assembly/Ring seat		1 no.				
1.02.17	Lower skirt		1 no.				
1.02.18	Lube Oil System						
	a) Pump assembly		2 nos.				
	b) Motor		2 nos.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	c) Pressure regulator		2 nos. for each type				
	d) Filters		8 nos.				
	e) Pump & Motor coupling		2 nos.				

* One set means one complete replacement of one mill.

1.03.00 Feeders

1.03.01	Belt	5 sets *
1.03.02	Belt drive motor	4 nos.
1.03.03	Belt drive reducer	4 nos.
1.03.04	Clean out conveyor motor	2 nos.
1.03.05	Clean out conveyor reducer	2 nos.
1.03.06	Counter assembly	1 no.
1.03.07	Head pulley assembly (complete)	1 no.
1.03.08	Weight sensing system	
	a) Weighting roll	1 no.

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	b) Weighting spare roller assembly		1 no.				
	v) Drag link assembly		1 no.				
1.03.09	Tension roll		1 no.				
1.03.10	Worm		1 no.				
1.03.11	Worm wheel		1 no.				
1.03.12	Feeder gate		1 no.				
1.03.13	Actuator		1 no. of each type				

* One set means one complete replacement of one feeder

1.04.00 Coal Burners/Coal Pipe Bends

1.04.01	Coal compartment assembly	3 sets**
1.04.02	Inter air compartments	1 set **
1.04.03	Oil compartments/oil nozzle tips	1 set **
1.04.04	End air compartment	1 set **
1.04.05	Coal nozzle castings	1 set **

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.04.06	Adjustable coal nozzle tips		1 set **				
1.04.07	Coal pipe bends with liners		15 nos. for each type size, thickness & radius				
1.04.08	Victualic couplings		15 nos. of each size				
1.04.09	Victualic coupling gasket		20 nos. of each size				
** One set means one complete replacement for a unit							
1.05.00	Seal Air Fan						
1.05.01	Impeller with shaft		1 no.				
1.05.02	Bearings & seals		2 sets *				
1.05.03	Motor bearings		2 sets*				
1.05.04	Motor		1 no.				

* One set means complete replacement of one fan

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.06.00	Regenerative Air Preheater						
1.06.01	Support Bearing		2 nos.				
1.06.02	Guide Bearing		2 nos.				
1.06.03	Lubricating system of support & Guide Brg						
	a) Pump assembly		2 nos.				
	b) Pump motor		2 nos.				
	c) Pressure regulator		1 no.				
	d) Filters		4 nos.				
	e) Pump motor coupling		2 nos.				
1.06.04	Radial seals		4 sets *				
1.06.05	Axial seals		3 sets *				
1.06.06	Circumferential or bypass seals		2 sets *				
1.06.07	Rotor post seals		3 sets *				
1.06.08	Air motor		3 nos. *				
	a) Bearings & seals for air motor		2 sets *				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.06.09	Complete speed reducer		2 set *				
	a) Speed reducer gears, pinions & shaft		1 set *				
	b) Speed reducer bearings		1 set *				
	c) Speed reducer seals & gaskets		1 sets *				
	d) Speed reducer clutch assembly		2 nos.				
1.06.10	Fluid coupling		3 nos.				
1.06.11	Other couplings with inserts & fasteners		2 nos.				
1.06.12	Solenoid valves		2 nos. of each type				
1.06.13	Spare kit for rotor stoppage alarm		1 set *				
1.06.14	Spare kit for fire sensing device		1 set *				
1.06.15	Spare for cleaning device						
	a) Worm & worm wheel for gear reducer		1 set *				
	b) Coupling		1 set *				
	c) Bearing & seals for spec reducer		1 set *				
	d) Bearing for cleaning device		2 sets *				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

1.06.16	Bushings for worm gear reducer		1 set *				
1.06.17	Actuators		1 no. of each type				
1.06.18	Cold, intermediate & hot end baskets		1 sets each type and size *				

* One set means one complete replacement of one APH.

1.07.00 Fuel Oil System**1.07.01 Heavy fuel oil system**

a)	Fuel oil guns	2 sets *
b)	Oil gun nozzle (with back plate, mixing plate and cap nut)	2 sets *
c)	Oil gun flexible hoses (including for guide pipe, air line)	2 sets *
d)	Spares for Heavy Oil Pump	
i)	Complete cartridge assembly	2 sets*
ii)	Mechanical seals	2 sets*

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	iii)	Bearings including that of motor	2 sets*				
	iv)	Set of 'O' ring & seals	2 sets*				
	v)	Set of all types of bushes & sleeves	2 sets*				
	vi)	Set of gaskets	2 sets*				
	e)	Heavy oil pump relief valve complete with accessories	2 nos				
	f)	Spares for oil pump relief valve					
	i)	Valve spindle & disc	1 no.				
	ii)	Set of gasket	1 set*				
	iii)	Sealing ring	1 set*				
	iv)	Springs	1 set*				
	g)	Burner isolation valves	12 nos. or 10% whichever is higher				
	i)	Gaskets for above valves	1 set*				
	ii)	Gland packings for above valves	1 set*				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	h) Heavy oil pressure control valve		2 nos.				
	i) Heavy oil main trip valve complete		2 nos				
	j) Atomising steam pressure reducing valve		2 nos.				
	k) Heavy oil temperature control valve		2 nos.				
	l) Actuators of above valves		1 no. of each type & rating				
1.07.02	Light Oil System						
	a) Light Oil gun		10% of population				
	b) Oil gun nozzle (with back plate, mixing plate & cap nut)		2 sets*				
	c) Light Oil pump						
	i) Complete cartridge assembly		2 sets*				
	ii) Mech. Seals		2 sets*				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

iii) Bearings including that of motor 2 sets*

iv) Set of 'O' rings & seals 1 set*

v) Set of all types of bushes & sleeves 2 sets*

vi) Set of gaskets 1 set*

* One set means one complete replacement of one equipment.

1.08.00 HEA Ignitors

1.08.01	HEA retractor	2 sets*
1.08.02	HEA spark rod	2 sets*
1.08.03	HEA spark tip	2 sets*
1.08.04	HEA exciter	4 nos. of each type and rating
1.08.05	Solenoid valves	-do-
1.08.06	Limit switch	4 nos. of each type and rating

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.08.07	Solenoid valve coil		8 nos. of each type and rating				
1.08.08	HEA spark gap		8 nos.				
1.08.09	HEA Transformer		8 nos.				
1.08.10	HEA rectifier		8 nos.				
1.08.11	HEA inductor		8 nos.				
1.08.12	Resistor		8 nos. of each type and rating				
1.08.13	Capacitor		-do-				
	* One set means one complete replacement of one HEA Ignitor .						
1.09.00	Soot Blowers						
1.09.01	Complete assembly of water wall deslagger		5 nos.				
1.09.02	Motor for water wall deslaggers		10 nos.				
	a) 5 nos. for rotary motion						
	b) 5 nos. for traverse motion						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.09.03	Complete valve assembly for water wall deslagger.		5 nos.				
1.09.04	Motor for long travel retractable soot blower.		6 nos.				
	a) 3 nos. for rotary motion						
	b) 3 nos. for traverse motion						
1.09.05	Complete valve assembly for long retractable soot blower.		1 no.				
1.09.06	Complete motor for air preheater soot blower		1 no. of each type If separate type & rating of SB are envisaged for RAPHs, then 1 No. of each type.				
1.09.07	Reduction gear box & motor for air preheater soot blower oscillation		1 no. of each type -do-				
1.09.08	Complete valve assembly for air preheater soot blower		1 no. of each type -do-				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.09.09	Bearing & oil seals for						
	a) Long retractable soot blower		2 sets*				
	b) Water wall deslagger		1 set*				
1.09.10	Complete steam safety valve assembly		1 no.				
1.09.11	Steam control valve assembly		1 no.				
	a) Stem & disc. assembly for above		2 sets*				
	b) Gaskets		2 sets*				
	c) Gland packings		2 sets*				
	d) Seat rings		2 sets*				
1.09.12	Long retractable soot blower assemblies complete.		1 no. of each type				
1.09.13	Limit switches		2 nos. of each type & rating				
1.09.14	Complete power pack assembly for Long Retractable soot blower		2 nos.(1 no. for rotary + 1 no. for transverse)				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.09.15	Spare set of rotary & transverse chain for long retractable soot blowers		1 no. of each type & size				
1.09.16	Spares for rack gear Assembly						
	a) Set of Gears & shaft(Spur & worm)		1 set *				
	b) Rack & pinion		1 set *				
1.09.17	Thermocouples for temperature probes		1 no. of each type & size				
	* One set means one complete replacement of one valve .						
1.10.00	VALVES						
1.10.01	Spares for Steam Drum/ Safety valves						
	a) Upper adjusting ring		2 nos. of each type				
	b) Lower adjusting ring		-do-				
	c) Locking pin set		-do-				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	d)	Safety valve disc	-do-				
	e)	Safety valve stem	-do-				
	f)	Valve spindle	2 nos.				
	g)	Guide	2 nos.				
1.10.02	Spares for SH Safety Valves						
	a)	SH safety valve assy	1 no.				
	b)	(i) Disc	2 nos. of each type				
		(ii) Upper adjusting ring	2 nos.				
		(iii) Lower adjusting ring	2 nos.				
		(iv) Valve spindle	2 nos.				
		(v) Set of washers	2 sets of each type*				
		(vi) Guide	2 nos. of each type				
		(vii) Set of locking pins	2 sets of each type*				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.10.03	Spares for Hot RH safety Valves						
	a) Disc		2 nos. of each type				
	b) Upper adjusting ring		2 nos. of each type				
	c) Lower adjusting ring		-do-				
	d) Valve spindle		-do-				
	e) Set of washers		2 set of each type*				
	f) Set of pins		2 nos. of each type				
	g) Guide		2 nos. of each type				
1.10.04	Spares for Cold RH safety Valves						
	a) Disc		2 no. of each type				
	b) Upper adjusting ring		-do-				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	c) Lower adjusting ring		-do-				
	d) Valve spindle		-do-				
	e) Locking pin set		2 sets of each type*				
	f) Guide		-do-				
	g) Set of washers		2 sets*				
1.10.05	Spares for Electromatic relief valve		1 no of each type				
	a) Complete Electromatic relief valve		2 nos. of each type				
	b) Spares for above :						
	(i) Disc for main valve		2 nos. of each type				
	(ii) Spring for main valve		-do-				
	(iii) Seal rings for main valve		-do-				
	(iv) Seal bushing for main valve		-do-				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(v) Disc & steam assembly for pilot valve		-do-				
	(vi) Bushing for pilot valve		-do-				
	(vii) Spring for pilot valve		-do-				
	(viii) Seal ring		-do-				
1.10.06	Spares for Superheater spray control valve						
	a) Spares for the above :						
	(i) Gland packings set		2 sets*				
	(ii) Pressure seal gasket		3 sets*				
	(iii) Stem		1 nos.				
	(iv) Plug valve		2 nos.				
1.10.07	Spares for Reheater spray control valve						
	a) Spares for the above :						
	(i) Gland packings set		2 sets*				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	b) Pressure seal gasket		3 sets*				
	c) Stem		1 no.				
	d) Plug valve		2 nos.				
1.11.00	Superheater Spray Block Valve Spares						
1.11.01	Gland packing set		2 sets of each type*				
1.11.02	Pressure seal gasket		2 nos. of each type				
1.11.03	Stem		2 nos. of each type				
1.11.04	Valve plug		2 nos. of each type				
1.12.00	Reheater Spray Block Valve Spares						
1.12.01	Gland packing set		2 sets of each type*				
1.12.02	Pressure seal gasket		2 nos. of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.12.03	Stem		2 nos. of each type				
1.12.04	Valve plug		2 nos. of each type				
1.13.00	Spares for boiler main steam stop valve						
1.13.01	Set of gland packings		2 sets*				
1.13.02	Pressure seal gaskets		3 nos.				
1.13.03	Stem		1 no. of each type (1 no. for main valve & 1 no. for integral bypass)				
1.13.04	Disc		1 no. -do-				
1.13.05	Seat rings		2 nos. -do-				
1.13.06	Fastners		1 no. -do-				
1.13.07	Actuator		2 nos. -do-				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.14.00	Boiler Feed Check Valve						
1.14.01	Body seat rings		2 nos.				
1.14.02	Flap		1 nos.				
1.14.03	Pressure seal ring		2 nos.				
1.14.04	Gland packings		2 sets*				
1.14.05	Fastners		1 set*				
1.15.00	Start up vent valve						
1.15.01	Stem		1 no.				
1.15.02	Disc		1 no.				
1.15.03	Body seat rings		2 sets*				
1.15.04	Gland packings		2 sets*				
1.15.05	Pressure seal rings		3 nos.				
1.15.06	Fastners		1 set*				
1.15.07	Startup vent valve assy		1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
1.16.00	Economiser Recirculation Valve (if applicable)						
1.16.01	Valve Stem		1 no.				
1.16.02	Disc		1 no.				
1.16.03	Body seat rings		1 set*				
1.16.04	Gland packings		1 set*				
1.16.05	Pressure seal rings		2 nos.				
1.17.00	Auxiliary Steam Pressure Reducing & Desuperheating System						
1.17.01	High Capacity PRDS System (MS)						
	1.0 Desuperheater liners		1 set*				
	a) Steam pressure reducing cum desuperheating valves						
	(i) Stem		1 no.				
	(ii) Disc		1 no.				
	(iii) Body seat rings		2 nos. for each type, size and rating of valves				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(iv)	Gland packings	2 nos. for each type, size and rating of valves				
	(v)	Pressure seal ring	3 nos.				
	(vi)	Gasket	2 nos.				
	b)	Spray water line control valves					
	(i)	Valve trim including cage, plug, stem, seat rings, guide bushings, stem packing	1 no. for each size, type & rating of valves				
1.17.02	Low Capacity PRDS System (CRH)						
	a)	Steam pressure reducing valve					
	(i)	Stem	1 no.				
	(ii)	Disc	1 no.				
	(iii)	Body seat rings	2 nos. for each type/size				
	(iv)	Gland packings	2 nos. for each size, type & rating of valves				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(v)	Pressure seal ring	3 nos.				
	(vi)	Gaskets	2 nos.				
	b))	Spray water line control Valves					
	(i)	Valve trim including cage, plug, stem, seat rings, guide bushings, steam packing	1 no. for each size, type & rating of valves				
1.18.00	VFD system						
1.18.01	Electrical Cards						
	a)						
	i)	Control modules	2 no. of each type & rating				
	ii)	I/O module	2 nos. of each type & rating				
	iii)	Power supply modules	2 nos of each type & rating				
	iv)	Thyristor gate module including gate transformer	110% of installed quantity				
	v)	Exiter module	1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	b) Thyristor bridge leg		10%				
	c) Over voltage limiter and surge suppressor network		1 set				
	d) Power & Control fuse		100% of installed quantity				
	e) Control Transformer		1 no. of each type & rating				
	f) Contactor/load break switch		1 no.				
	g) CT/VT		1 no. of each type & rating				
	h) Indicating lamps		100% of each type & rating				
	i) Auxiliary contactors & relays		10% of installed quantity				
	j) Panel mounted meters		1 no. of each type & rating				
	k) Panel mounted printer		1 no.				
	l) Parameter tuning device		1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	m)	Indicating lamp holder full set	10% of each type/colour				
	n)	Semiconductor fuses for thyristor	1set				
1.18.02	LT Transformer (VFD)						
	a)	(i) Primary	3 Nos. each rating				
		(ii) Secondary	3 nos. each rating				
	b)	Winding temperature indicator with alarm & trip contacts	1 no.				
	c)	Oil temperature indicator with alarm & trip contacts	1 no.				
	d)	Magnetic oil level gauge	1 no.				
	e)	Pressure relief device	1 no.				
	f)	Diaphragm for explosion vent	1 no.				
	g)	Buchholz relay/sudden pressure relay (as applicable)	1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	h) Silca get charge		1 charge				
	i) Floats with contacts for buchholz relay		1 set				
	j) Set of gaskets		1 set				
	k) Contacts tap changer		1 set				
	l) Set of valves (1 no. of each size)		1 set				
	m) Pressure gauge (applicable for sealed tank)		1 no. of each type				
	n) Set windings for one limb in a suitable oil container		1 for each rating				
1.18.03	Electrostatic Precipitator (ESP)						
	(a) Support insulator		4 nos.				
	(b) Shaft insulator		6 nos.				
	(c) Emitting electrodes						
	(i) Helical wire type		5% of the installed quantity in one set of ESPs for each SG				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(ii) Wire pipe in rigid frame		10% of the installed quantity in one set of ESPs for each SG				
	(iii) Mast type		2% of the installed quantity in one set of ESPs for each SG				
	(d) Collecting electrode		2% of the installed quantity in one set of ESPs for each SG				
	(e) Inner arm assembly		20 nos. each for collecting & emitting system				
	(f) Outer arm assembly		10 nos. each for collecting & emitting system				
	(g) Plain bearing		20 nos. of each type and size				
	(h) Shock bar/anvil		60 nos. of each type and size				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(i) Rappers						
	(a) For electric rappers						
	(i) Assembled rapper/ dop rods		20 nos. of each size and type				
	(ii) Coil assembly along with sleeve		4 nos.				
	(iii) Casing		4 nos.				
	(iv) Gaskets & packing		4 nos. of each size and type				
	(b) For tumbling rappers						
	(i) Hammers		20 nos. of each size and type				
	(ii) Bearing components		4 nos.				
	(iii) Shafts		4 nos.				
	(iv) Gear motors		8 nos.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(j) Transformer rectifier set						
	(a) Complete set		1 no.				
	(b) High voltage insulator		2 nos.				
	(k) Switches and Gaskets (One set means one complete replacement for all the TR sets of one Boiler)		1 set				
	(l) Control Switch						
	(i) Transformer-rectifier set controller		1 no.				
	(ii) Rapper controller complete		1 no.				
	(iii) Communication controller complete		1 no.				
	(iv) Electronic cards						
	(a) For rapper controller & ESP management system		1 set				
	(b) For transformer rectifier controller		1 set				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(v) Display unit		1 no. of each type				
	(vi) Keyboard		1 no. of each type				
	(vii) Push buttons for						
	(a) TR set controller		2 sets				
	(b) Others		1 set				
	(viii) Indicator lamps		1 set				
	(ix) Control fuse		1 set				
	(x) Power fuse		1 set				
	(xi) Thyristor fuse		1 set				
	(xii) Thyristor of transformer rectifier controller		2 sets				
	(m) MCC Auxiliary Control Panel						
	(i) Breaker		1 set				
	(ii) Power contacts		1 set				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(iii) Auxiliary relays		1 set				
	(iv) Over load relay		1 set				
	(v) Power fuse		1 set				
	(vi) Contact fuse		1 set				
	(vii) Control terminal block		1 set				
1.19.00	FLUE GAS DESULPHURISATION SYSTEM						
1.19.01	Gates in Flue Gas System						
	a) Seals		1 set of each type (Set means complete replacement for one gate)				
	b) Actuator		1 no. of each type				
1.19.02	Gas-Gas Heater						
	a) Regenerative Ljungstrom Type (if applicable)						
	i) GGH Electric Motor complete		1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	ii)	Support Bearing	1 No.				
	iii)	Guide Bearing	1 no.				
	iv)	Lubricating system of support & Guide Brg					
	a)	Pump assembly	1 no. of each type				
	b)	Pump motor	1 no. of each type				
	c)	Pressure regulator	1 no. of each type				
	d)	Filters	2 nos. of each type				
	e)	Pump Motor coupling	1 no of each type				
	v)	Radial seals	2 sets*				
	vi)	Axial Seals	2 sets*				
	vii)	Circumferential or bypass seals	2 sets*				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	viii)	Rotor post seals	2 sets*				
	ix)	Heating Element	1 set*				
	x)	Air Motor	2 nos.				
	xi)	Complete Speed reducer	1 set*				
	a)	Speed reducer Gears, pinions & shaft	1 set*				
	b)	Speed reducer Bearings	1 set*				
	c)	Speed reducer Seals & gaskets	2 sets*				
	d)	Speed reducer Clutch assembly	1 no				
	xii)	Couplings with inserts & fasteners	2 nos.				
	xiii)	Solenoid valves	2 nos				
	xiv)	GGH Cleaning Device					
	a)	Lance and Nozzle	1 no.				
	b)	Drive assembly including Gearbox and motor	1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	c)	Valve assembly with actuator	1 no.				
	d)	Pump assembly (if applicable)	1 no.				
	b)	Heat Pipe Type Heat Exchanger (If applicable)					
	i)	Finned Tube	20% of each type, size, thick- ness, material				
	ii)	Pump impeller assembly (if applicable)	1 no.				
	iii)	Pump Bearings	1 no. of each type				
	iv)	Coupling	1 no.				
	v)	Motor	1 no.				
	c)	Absorber					
	i)	Liner Material	5% coverage of each material and thickness for one Unit/ Absorber				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	ii) Absorber Spray/ Oxidation nozzles		20% of each type				
	iii) Absorber Mist Eliminator Washing Nozzles		10% of each type				
	iv) Absorber Mist Eliminator		5% of each type				
	d) Oxidation Air Compressor						
	i) Impeller Assembly		1 no.				
	ii) Bearings		1 no. of each type				
	e) Agitators (For Absorber Oxidation Tank, Mill Separator Tank, Limestone Slurry Preparation Tank and any other tank provided with agitators)						
	i) Impeller Assembly		1 no. of each type				
	ii) Bearing Assembly		1 no. of each type				
	iii) Motor		1 no. of each type				
	iv) Belt and Pulley (If applicable)		1 no. of each type				
	v) Gear Box Assembly (If Applicable)		1 no. of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	f) Slurry Pumps (Absorber Slurry Recirculation Pump, Gypsum Bleed Pumps, Mill Circuit Pump, Limestone Supply Pumps and any other slurry pumps)						
	i) Impeller Assembly		1 no. of each type				
	ii) Casing Liners		1 no. of each type				
	iii) Seals		1 set of each type				
	iv) Bearings		1 no. of each type				
	v) Motor		1 no. of each type				
	vi) Motor-Pump Coupling		1 no. of each type				
	g) Hydro-cyclones (Mill, Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone)						
	i) Hydro-cyclone Isolation Valve		10% of each type				
	ii) Hydro-Cyclone		10% of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

h) Feeders

i)	Belt	2 sets*
ii)	Belt drive motor	1 no.
iii)	Belt drive reducer	1 no.
iv)	Speed Reducer Assembly	1 set*
v)	Weighing Instruments	1 set*

i) Limestone Mills

i)	Mill Wear Parts (Liners)	1 sets

Note : One set of Mill Wear Parts (Liners)
above is defined as under :

1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 x 1) / GWL,
rounded off to nearest higher whole number.

Where :

GWL = Guaranteed wear life of Mill Wear Parts as offered by the bidder.

ii)	Mill Motor	1 no.
iii)	Auxiliary Motor	1 no.

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	iv)	Gear box internals (including Bearings and Seals)	2 sets*				
	v)	Complete Gear Box	1 sets*				
	vi)	Mill motor Bearings	2 sets*				
	vii)	Lube Oil / Grease System					
	a)	Pump assembly	1 nos. of each type				
	b)	Motor	1 nos. of each type				
	c)	Pressure regulator	1 nos. of each type				
	d)	Filters	2 nos. of each type				
	e)	Pump & Motor coupling	1 nos. of each type				
	j)	Slurry Valves	2 no. of each type				
	k)	Slurry Line Bends	2 no. of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	l) Vacuum Belt Filter						
	i) Filter Cloth		5 sets				
	ii) Belt (if applicable)		2 sets				
	iii) Vacuum Box Seals		3 sets				
	iv) Drive Motor (if applicable)		1 no.				
	m) Vacuum Pumps						
	i) Pump Impeller Assembly		1 no.				
	ii) Pump Bearing		1 set				
	iii) Seals		1 set				
	iv) Motor		1 no.				
	n) Vacuum Breaker Valves						
	i) Valve Assembly		1 no.				
	ii) Actuator		1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
o) Sump Pumps							
	i) Complete Impeller Assembly		1 no. of each type				
	ii) Casing Liners		1 set* of each type				
	iii) Bearing		1 set*				
	iv) Motor		1 no. of each type				
	v) Pump discharge valve assembly		1 no. of each type				
p) Horizontal Centrifugal Pumps							
	i) Complete Impeller Assembly		1 no. of each type				
	ii) Casing Liners		1 set* of each type				
	iii) Bearing		1 set*				
	iv) Motor		1 no. of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

v) Pump discharge valve assembly 1 no. of
each type

Note:

- Any change in size, material, design etc, which obviates one to one replacement of the part shall be considered a different type.

* Unless otherwise stated, a set shall mean complete replacement for one equipment.

1.20.00 Elevators**1.20.01 Goods Cum Passenger Elevator**

- Friction block 2 nos.
- Guide roller of each type 20% of total
population or
3 nos. of type
whichever is
higher
- Contactors of each type 2 nos.

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	d) Control transformer		1 no. of each type				
	e) Time device		2 nos. of each type				
	f) Rectifiers		2 nos. of each type				
	g) Overcurrent relay		2 nos. of each type				
	h) Auxiliary relay		3 nos. of each type				
	i) Resistor		3 nos. of each type				
	j) Fuses of each rating		20% of the total population				
	k) Limit switches of each type		3 nos.				
	l) Push button		3 nos. of each type				
	m) Contact device (if applicable)		3 nos. of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	n) Brake motor		2 nos. of each type				
	o) Transmitters		2 nos. of each type				
	p) Switches of each type		3 nos.				
	q) Receiver		2 nos. of each type				
	r) Bearings of each type & size		2 nos.				
	s) Roller of each type		3 nos.				
	t) Worm gear spares						
	(a) 'O' rings		3 sets*				
	(b) Sealing ring of each type		3 sets*				
	u) Spares for brake						
	(i) Fan		2 nos. of each type				
	(ii) Magnetic coil		3 nos. of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(iii) Brake disc		2 sets*				
	(iv) Brake pad		2 sets*				
	v) Bushing (for door front)		2 sets*				
	w) Pinion		2 nos. of each type				
	** One set means one complete replacement for a unit.						
	* One set means one complete replacement for an equipment.						
2.00.00	EQUIPMENT COOLING SYSTEM, CHEMICAL DOZING, PLATE TYPE EXCHANGER						
2.01.00	DMCW Pumps						
2.01.01	Impeller		Nil				
2.01.02	Shafts		1 No.				
2.01.03	Shaft Sleeve		2 Nos				
2.01.04	Casing wearing rings (if applicable)		1 set				
2.01.05	Impeller wearing rings (if applicable)		1 set				
2.01.06	Bearings for the pumps		1 Set of each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
2.01.07	Motor Bearings		1 set of each type				
2.01.08	Thrust Bearings (if applicable)		1 set of each type & size				
2.01.09	Sleeve nuts and O-rings		1 set of each type and size				
2.01.10	Gland & Gland Packing (if applicable)		Nil				
2.01.11	Fastners		Nil				
2.01.12	Complete Coupling (Pump and Motor)		Nil				
2.01.13	Mechanical seal (if applicable)		1 set of each type				
2.02.00	Plate Type Heat Exchangers						
2.02.01	Gaskets		5% of total requirement of each type & size				
2.02.02	Fasteners		Nil				
2.02.03	Plates		2% each type				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
2.03.00	AIR COMPRESSORS / ADP / COMPRESSOR HOUSE CRANE						
2.03.01	H. P. Stage						
	Complete HP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.		1 Set of each type/ rating				
2.03.02	L. P. Stage						
	Complete LP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial		1 Set of each type/ rating				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts.						
2.03.03	Motor Bearings		1 Set				
2.03.04	LP stage Gear and Pinion		1 Set				
2.03.05	HP stage Gear and Pinion		1 Set				
2.03.06	Air Intake Filter Element With Gaskets		2 Sets				
2.03.07	Oil Filter Element With Gaskets & Seals		2 Sets				
2.03.08	Safety Valve Springs and Gaskets for HP stage		1 Set				
2.03.09	Safety Valve Springs and Gaskets for LP stage		1 Set				
2.03.10	VALVES (within the Compressor house) WITH ACTUATORS		1 nos of each type/rating/size				
2.03.11	OIL PUMP/MOTOR						
	(a) Oil Pump & Motor Complete Assembly		Nil				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(b) Pump Impeller/ Rotor with shaft		1 Set				
	(c) Set of Bearings		1 Set				
	(d) Set of Seals		1 Set				
2.03.12	DRAIN / MOISTURE TRAPS		1 set of each type / size.				
2.03.13	OIL COOLER GASKETS & SEALS		1 Set				
2.03.14	AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM						
	(a) Prefilter Element (Ceramic Candle or as applicable)		1 Set				
	(b) After Filter Element (Ceramic Candle) (Ceramic Candle or as applicable)		1 Set				
	(c) Heater Element (if applicable)		1 Set				
	(d) Blower Bearing (if applicable)		1 Set				
	(e) Blower Motor Bearing (if applicable)		1 Set				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(f) Valves & Valve Actuators		1 No.				
	(g) Heater Coil for temperature Stabilisation (for HOC Type) (as applicable)		1 Set				
2.03.15	COMPRESSOR HOUSE CRANE						
	(a) All bearings		Nil				
	(b) Brake assembly and its liners		1 set of each type/rating				
	(c) Wire rope		Nil				
3.00.00	MANDATORY SPARES:						
3.01.00	PCP						
3.01.01	Spare gaskets for all the gate valve for sizes 15 mm NB to 500 mm NB		Nil				
3.01.02	Spare sets of gland packings of all the gate valves for all sizes		Nil				
3.01.03	Spare gaskets for all the globe valves for sizes 15 mm NB to 500 mm NB		Nil				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
3.01.04	Spare sets of gland packings for all the Globe valves for all sizes		Nil				
3.01.05	Spare gaskets for NRV for all the valves		Nil				
3.01.06	Spare set of Gaskets for safety relief valves, for all sizes		Nil				
3.01.07	Complete gate valves assly. Upto the size of 50 NB		Nil				
3.01.08	Complete angle valves only upto the size of 50 NB		2 nos				
3.01.09	Complete Globe valves up to the size of 50 NB		2 nos				
3.01.10	Complete NRV's Assly. upto the size of 50 NB		2 nos				
3.01.11	Complete needle valves upto the size of 50 NB		2 nos				
3.01.12	Spring hangers (Variable spring & Constant spring hangers)		Nil				

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Note:Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied.

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

3.02.00 LP PIPING

Valves :5% of the total population of each type, size and class or minimum 1 no. of each type, size and class, whichever is higher.

Note : Wherever valves are specified as mandatory spare, complete valve along with actuator and all other accessories which are the part of original supply shall also be supplied.

4.00.00 MANDATORY SPARES FOR LT SWITCHGEAR (AS APPLICABLE)

4.00.01 Complete pole of breaker

4.00.02 Spring charging motors

4.00.03 Aux. contact set

4.00.04 Limit switches

4.00.05 Arc chutes

4.00.06 Fixed contact set

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
4.00.07	Moving contact set						
4.00.08	Arcing contact						
4.00.09	Charging spring						
4.00.10	Current transformer (metering)						
4.00.11	Current transformer (protection)						
4.00.12	Closing coil						
4.00.13	Trip coil						
4.00.14	CT for Bimetal O/L relays						
4.00.15	Voltage transformer						
4.00.16	Control supply transformer						
4.00.17	Ammeter						
4.00.18	Voltmeter						
4.00.19	Relays						
4.00.20	Power contactor						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
4.00.21	Coil of above contactor						
4.00.22	Air break switches						
4.00.23	DP air break switches (DC)						
4.00.24	Control & selector switches						
4.00.25	Control fuses & neutral links						
4.00.26	Indicating lamps						
4.00.27	Bus bar support insulators (each type)						
4.00.28	Bus duct flexibles connectors						
4.00.29	Primary disconnect in MCC (Male/ femal contact)						
4.00.30	Push buttons						
4.00.31	Power fuses						
4.00.32	Thermal bimetal relays						
4.00.33	Indication Lamp Holders complete						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
4.00.34	Maintenance tools and accessories for Maintenance (bidder to list)						
4.00.35	Terminal blocks						
4.00.36	Busbar alluminium flat pieces						
4.00.37	Busbar angles/formed pieces for breaker						
	NOTE: a. Quantity mentioned in percentage (%) is the % of total installed. b. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.						
5.00.00	DISTRIBUTED DIGITAL CONTROL MONITORING AND INFORMATION SYSTEM (DDCMIS) (INCLUDING UNITS –SG C&I AND FUEL OILSYSTEM)						
5.01.00	Peripherals						
5.01.01	Keyboard		2 Nos. of each type.				
5.01.02	Mouse		2 Nos. of each type.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
5.01.03	Color laser printer (A4)		One No.				
5.01.04	Color laser printer (A3)		One No.				
5.01.05	Blank Compact discs		10 boxes				
5.01.06	Long term storage unit		One No.				
5.02.00	HMIPIS Devices						
5.02.01	Work stations		One No. of each type and model.				
5.02.02	Server for unit LAN or Information workstations (as applicable)		One No. of each type and model				
5.02.03	Net work components like switch/repeaters/hubs etc.		2 Nos. of each type and model.				
5.02.04	Other drives/peripheral devices of each type and model no. in MMIPIS like terminal Servers, DAT tape drive etc. (as applicable), which are not covered in above items but are required to make the system complete.		2 Nos. of each type and model				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
5.02.05	Control unit for LVS		One No.				
5.03.00	Cables and Connectors.						
5.03.01	Prefab interconnecting cables with connectors		2 Nos. of each type and length, whichever is more.				
5.03.02	System bus cable with connectors		2 Nos. of each type and length, whichever is more.				
5.03.03	I/O bus cable with connectors for remote I/O units		2 Nos. of each type and length, whichever is more.				
5.04.01	Power Supply Modules & Power Packs for control system		10% of each type, model and rating				
5.04.02	Intelligent UPS for workstation, server, PCs		One No. of each size and rating				
5.05.00	Electronic modules of each type and model for control system (This shall include all type of cards like I/O cards, controller cards, CPU module or Card, logic cards etc.)		10% or 2 Nos. of each type and model whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
5.06.00	Bus coupler/Interface hardware/other Communication devices		10% of each type				
5.07.00	Relays		10% of each type				
5.08.00	PCs		One No. of each type & model.				
5.09.00	Batteries used for battery backup of RAMs.		10 % of each type and model.				
5.10.00	Fuses		200 %.				
5.11.00	Expendable items including but not limited to the following Cooling fans for Power supply and cabinets		10% of each type and model.				
6.00.00	OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS/ EQUIPMENTS						
6.01.00	Other SG related sub-systems						
6.01.01	Flame Monitoring System						
	(a) Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fibre optic cables.		20% or 4 Nos., whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(b) Flame Scanner Lens.		100%				
	(c) Electronic cards for scanners		10% or 2 Nos. of each type whichever is more.				
	(d) Power Supply Modules		10% or 2 Nos. of each type whichever is more.				
6.01.02	Coal Feeders						
	(a) Motion monitor		10% or 2 Nos. whichever is more.				
	(b) Speed pick-up		10% or 2 Nos. whichever is more.				
	(c) Torque switch		10% or 2 Nos. whichever is more.				
	(d) Load Cell		10% or 2 Nos. whichever is more.				
	(e) Electronic cards & Power Supply cards		10% or 2 Nos. whichever is more.				
	(f) Clutch (if applicable)		10% or 2 Nos. whichever is more.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(g) Local indication lamps		200 %				
	(h) Panel meters		10% or 2 Nos. whichever is more.				
	(i) Limit switch assembly for coal-on-belt, no coal flow, shear pin failure, etc.		10% or 2 Nos., whichever is more.				
	(j) Coupling (eddy current type etc., if applicable)		10% or 2 Nos. whichever is more.				
6.01.03	Electromatic Safety Valves						
	Pressure switches, local PB stations and solenoid Valves.		10% or 2 Nos. of each type whichever is more.				
6.01.04	Furnace Temperature Probes						
	Thermocouple		2 Nos.				
6.01.05	Acoustic Pyrometers						
	(a) Signal Processor and interface modules		20% or 2 Nos. of each type and model which- ever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(b) Sensors and Transceivers		20% or 2 Nos. of each type and model which is more.				
	(c) All Electronic Cards including Power Packs		20% or 2 Nos. of each type and model which is more.				
6.01.06	Furnace and Flame Viewing System						
	(a) Flame Cameras		10% or 2 Nos, whichever is more				
	(b) Electronic Modules		10% or 2 Nos. of each type whichever is more				
6.01.07	Electronic remote drum level monitoring system (in case of drum type boilers)						
	(a) Electrodes		50% of population.				
	(b) Electronic Cards		20% or 2 Nos. of each type and model whichever is more.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(c) Lamps/LEDs of display units		100%				
6.01.08	Mill and Air heater Fire detection system.						
	(a) Thermocouple		10%				
	(b) Process actuator switches		10%				
6.01.09	Acoustic Steam Leak Detection System						
	(i) Signal Processor and interface modules		10% or 2 nos. of each type and model whichever is higher				
	(ii) Sensors and Transceivers		20% or 2 nos. of each type and model whichever is higher				
7.00.00	MEASURING INSTRUMENTS						
7.01.00	Electronic Transmitters						
	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)		10% of each type and model and model				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
7.02.00	Temperature elements						
7.02.01	RTD's* of each type and length		10% or 2 Nos. whichever is more				
7.02.02	Thermocouples of each type like K-type, R-type, metal etc. and length *		10% or 2 Nos. whichever is more				
7.02.03	Cold junction compensation boxes of each model		10% or 2 Nos. whichever is more				
7.02.04	Thermostatic units for each model of CJC box.		10% or 2 Nos. whichever is more				
7.02.05	Thermowell for application like mill outlet temperature and SH/ RH/Eco/ true gas temp. in furnace		10% or 2 Nos. whichever is more				
7.02.06	Temperature transmitters		10% of each type				
	* (with head assembly, terminal block and nipple)						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
7.03.00	Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,		5% or One No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, model, type population)				
7.04.00	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices		5% or 1 No. of each type and model whichever is more				
7.05.00	Electrical Metering Instruments Electrical meters including voltmeter, motor current ammeter,		5% or 1 No. of each model and type which- ever is more				
7.06.00	PD Type Flow Transmitters		5% or 1 Set of each type and model whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
7.07.00	pH Analysers		5% or 1 Set of each type and model whichever is more				
7.08.00	Density Meters		5% or 1 Set of each type and model whichever is more				
7.09.00	Mass Flow Meters		5% or 1 Set of each type and model whichever is more				
7.10.00	Flue Gas Sox Analyser		1 no. each complete Instrument				
7.10.01	Electronic Card Assemblies of each type		10%				
7.10.02	Sets of Gaskets/"O" rings		2 sets.				
7.10.03	Temperature Sensor & heater assembly		20%				
7.10.04	Complete Probe with shield assembly		2 nos.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
7.10.05	Air flow meter		1 no.				
7.10.06	Consumables like filter elements light sources etc.		100%				
7.10.07	Calibration gases of all types and ranges		One year supply.				
8.00.00	POWER SUPPLY SYSTEM						
8.01.00	24 V DC power supply system (To be Supplied for each 24 V DC Power Supply System)						
8.01.01	Silicon controlled thyristers, diodes, power transistors		100%				
8.01.02	Capacitors		One Set				
8.01.03	Fuses of each types and rating		200%				
8.01.04	Fuse free Circuit breakers		5% or One No. of each type and rating, which- ever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
8.01.05	Electronic modules of all types		10% or 2 Nos. of each type and model, whichever is more				
8.01.06	Indication Lamps		100%				
8.01.07	Lamp holders with series resistor, if any		10% or 2 Nos. of each type, whichever is more.				
8.01.08	Cooling Fans		10% or 2 Nos. of each type, whichever is more.				
8.01.09	Digital/analog panel meters/ indicators whichever is more.		5% or 1 No. of each type				
8.01.10	Relays of all types including overload relays		10% or 2 Nos. of each type whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
9.00.00	PROCESS CONNECTION PIPING (FOR IMPULSE PIPING/TUBING, SAMPLING PIPING/TUBING AND AIR SUPPLY PIPING AS APPLICABLE)						
9.01.00	Valves of all types and models		10% or 1 No. of each type, class, size and model whichever is more.				
9.02.00	2 way, 3way, 5way valve manifolds		10% or 1 No. of each type, class, size and model whichever is more.				
9.03.00	Fittings		10% or 1 packet of each type, class, size and model whichever is more.				
9.04.00	Purge meters		5% of each model or 2 Nos. whichever is less				
9.05.00	Filter regulators		20% of each model or 2 Nos. whichever is less				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
10.00.00	INSTRUMENTATION CABLE, INTERNAL WIRING						
10.01.00	Pre fabricated cable of each type		10% of installed quantity				
10.02.00	Pre fabricated cable connector of each type		10% or 1 No. of each type and model, whichever is more.				
10.03.00	Other cables		5 % of each type, pair and size of actual installed quantity				
11.00.00	CONTROL VALVES, ACTUATORS & ACCESSORIES						
11.01.00	Pneumatic and electro-hydraulic actuator assembly		10% or 1 No. of each type, model and rating, whichever is more				
11.02.00	Position feed back transmitter		20% or 2 Nos. of each type, whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
11.03.00	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)		One Set for each type of control valve, whichever is more				
11.04.00	Diaphragms, O' rings, seals etc. of all types, make etc.		200%				
11.05.00	Pneumatic air-filter/Regulator of each type, make, rating etc.		10% or 2 Nos. whichever is more				
11.06.00	Pressure Gauges of all types, make, rating etc.		10% or 2 Nos. of each type whichever is more				
11.07.00	Solenoid valves		10% or 2 Nos. of each type whichever is more				
11.08.00	Air lock relays		10% or 2 Nos. of each type whichever is more.				
11.09.00	Pneumatic relays		10% or 2 Nos. of each type whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
11.10.00	Positioner unit		20% or 1 No. of each type whichever is more				
12.00.00	MICROPROCESSOR BASED/PLC BASED CONTROL SYSTEM						
12.01.00	Power Supply Unit		20 % or 2 Nos. of each type and model, whichever is more				
12.02.00	Electronic modules		10 % of each type and model				
12.03.01	Interconnecting Cables		One run length of each type and size				
12.03.02	Connectors		10%				
12.04.00	Graphical Interface Unit		One No. of each size				
12.05.00	Printer		One No.				
12.06.00	Cooling Fan in PLC system/cabinet		10% or 2 Nos. whichever is more				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
12.07.00	Audible devices		10% or 2 Nos. of each type whichever is more				
13.00.00	PADO						
13.01.00	Work station with all accessories and licensed software		One No.				
13.02.00	Sensors		10% or 2 Nos. of each type whichever is higher				
13.03.00	Interface cards		10% or 2 Nos. of each type whichever is higher				
13.04.00	Power Packs		10% or 2 Nos. of each type whichever is higher				
13.05.00	Prefab cables		10% or 2 Nos. of each type whichever is higher				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
14.00.00	MANDATORY SPARES FOR MILL REJECT HANDLING SYSTEM :						
14.01.00	Pneumatic conveying system						
14.01.01	Pneumatic main valves		8 set of each type				
14.01.02	Pneumatic / solenoid twoee position control valve		8 sets of each type				
14.01.03	Plate/dome valve (including seals) with actuators		16 Nos.				
14.01.04	Plate / Dome valve seals		16 Sets				
14.02.00	Compressures Reciprocating Compressors						
14.02.01	HP Cylinder						
	(a) Small end bearing		2 sets				
	(b) Big end bearing		2 sets				
	(c) Piston ring (including all rings over piston)		4 sets				
	(d) Oil wiper ring		2 sets				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(e) Suction valve		2 sets				
	(f) Discharge valve		2 sets				
	(g) Packing set		2 sets				
14.02.02	LP Cylinders						
	(a) Big end bearing		2 sets				
	(b) Small end bearing		2 sets				
	(c) Piston ring (including all rings over piston)		4 sets				
	(d) Oil wiper ring		1 set				
	(e) Suction valve		1 set				
	(f) Discharge valve		1 set				
	(g) Packing set		1 set				
14.02.03	Cross Head						
	(a) Throw away guide		1 no.				
	(b) Crank shaft		1 no.				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(c) Main bearings		1 set				
	(d) Piston LP		1 No.				
	(e) Piston HP		1 No.				
	(f) Connection rod		1 no. of each type				
	(g) Packing ring		1 set				
	(h) Sealing ring HP		1 set				
	(i) Sealing ring LP		1 set				
	(j) Spring decompressor		1 set				
	(k) 'O' ring piston		1 set				
	(l) Protection grill		1 set				
	(m) Ring copper		1 set				
	(n) Valve plate		1 set				
	(o) Cushion plate		1 set				
	(p) Spring plate		1 set				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(q) Type coupling		Nil				
14.02.04	Valves						
	(a) Check valve flap or disk		1 set				
	(b) Control valve disc with internal assembly		1 set				
	(c) Control valve gasket		Nil				
	(d) Control valve gland piping		Nil				
	(e) Gate, globe, shuttle check valve		1 no. of each type				
	(f) Gasket & seals of inter cooler		1 set				
	(g) Gasket and seals for after cooler		2 sets				
14.02.05	Oil Pump / Motor						
	(a) Oil pump complete assembly		1 set				
	(b) Pump impeller / rotor with shaft		1 set				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
	(c) Set of bearing		1 set				
	(d) Set of seal		1 set				
14.02.06	SHAFT DRIVE OIL PUMP						
	(a) Drive gear with shaft		1 no.				
	(b) Driven gear with shaft		1 no.				
	(c) Driven pump element		1 set				
	(d) Oil cooler gasket & seals		1 set				
	(e) Moisture pump element		1 set				
15.00.00	FUEL OIL HANDLING AND STORAGE SYSTEM						
15.01.00	Strainer elements						
15.01.01	H.F.O. unloading pumps		2 nos.				
15.01.02	F.O. Drain pumps		1 no.				
15.01.03	L.F.O. unloading pumps		1 no.				
15.02.00	Floor Coil Heater						

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
15.02.01	H.F.O. storage tank		15% of total length of coil for one (1) no. H.F.O. storage tank				
15.02.02	Oil water separator pit		15% of total length of coil				
15.03.00	Relief valve complete assembly						
15.03.01	H.F.O. unloading pumps		1 no.				
15.03.02	L.F.O. unloading pumps		1 no.				
15.03.03	Pressure Reducing station		1 no.				
15.04.00	Bearings for						
15.04.01	H.F.O. unloading pumps		1 set				
15.04.02	L.F.O. unloading pumps		1 set				
15.04.03	F.O. Drain pumps		1 set				
15.05.00	Rotor assembly (complete cartridge assembly)						
15.05.01	H.F.O. unloading pumps		Nil				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
15.05.02	L.F.O. unloading pumps		Nil				
15.05.03	F.O. Drain pumps		Nil				
15.06.00	Coupling Bolts with nuts, washer and bushes for HFO/LFO unloading pumps		1 set for each size of coupling				
15.07.00	Wearings Rings		1 set for each type of pump				
15.08.00	Gland Packing (if applicable) of pump		1 set for each type				
15.09.00	Mechanical seal Assembly (if applicable)		1 set each for HFO/LFO unloading cum transfer pump				
15.10.00	Shaft sleeve		1 set for each type of pump				
15.11.00	Valves (each type and size)		a) 1 number, where the total quantity of a particular type and size of valve is less than or equal to 10				

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Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6
			b) 2 numbers, where the total quantity of a particular type and size of valve is less than 40 but more than 10				
			c) 5% of the total quantity (to nearest whole number) of a particular type and size of valve, where the total quantity of a particular type and size of valve is more than 40				
15.12.00	Steam Trap		1 no. of each type and size				
15.13.00	Control valve (complete assy.)		One (1) no. complete for floor coil heaters.				
			One (1) no. complete for suction heaters				

SCHEDULE - 1

Page 100 of 102

Item	Description	Code##	Qty.	# UNIT PRICE		# TOTAL PRICE (3 X 250 MW)	
				FOB	CIF (Indian port of Entry)	FOB	CIF (Indian Port of Entry)
1	2	3	4.	5	6	7=4x5	8=4x6

15.14.00 Pressure reducing valve One (1) no.

15.15.00 Neoprene rubber unloading hoses Ten (10) nos.
(for HFO) with end connections
(complete hose)

Note : One (1) set means total number
as required for one complete
replacement of one equipment

SUB - TOTAL (II) MANDATORY SPARES

**III. SUB-TOTAL OF TYPE TEST CHARGES
(AS PER FURTHER BREAK-UP OF TYPE
TEST CHARGES GIVEN IN SCHEDULE-8A)**

GRAND TOTAL (I) + (II) + (III)
To Grand Summary (Schedule - 5)

LOCAL AGENTS COMMISSION (IF, ANY) :
(included in FOB prices indicated above)

(a) Total weight of main equipment (excluding mandatory spares)..... (MT)

(b) Total weight of Mandatory Spares..... (MT)

Please state the currency and fill in the amount in figures and words.

Bidders shall enter a code representing the country of origin of all imported plant and equipment
(including mandatory spares)

S.No. Code Country

1

2

3

4

5

6

7

8

9

10

(Attach Separate Sheet if required)

Date : (Signature).....

Place : (Printed Name).....

(Designation).....

Common Seal).....

Notes :

1. Items listed above but priced in Schedule 2 will be struck off by the Bidder in this Schedule 1.
2. Unless stated otherwise a 'set' means items or sub-items required for each type/size/range of the assembly/sub-assembly, required for complete replacement in one equipment/systems as the case may be. It is further, intended that the assembly/sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or for any other reasons which result in maintaining two or more different sets of the spares to be used for the subject assembly/sub-assembly, these shall be considered as different types of assembly/sub-assembly.
3. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by the Bidder shall be the specified percentage (%) of the total population required to meet the specification requirements for 3x250 MW units. In case the quantity of mandatory spares so calculated happens to be a fraction, the same shall be rounded off to next higher whole number.
4. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.
5. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.
6. Bidders are required to indicate the break-up of Type Test Charges as per Schedule-8A.
7. In case the description/quantity for any item mentioned in this Schedule is at variance from what has been stated in the Technical Specifications and its subsequent amendments and clarifications, the stipulations of the technical specifications and its subsequent amendment and clarifications shall prevail.

SUB SECTION - IV

DETAILED TECHNICAL SPECIFICATION (CONTROL & INSTRUMENTATION SYSTEMS)

Consists of :

SUB-SECTION	DESCRIPTION
IV:I-01	BASIC DESIGN CRITERIA
IV:I-02	DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)
IV:I-03	SG RELATED CONTROL AND INSTRUMENTATION SYSTEM
IV:I-04	MEASURING INSTRUMENTATION
IV:I-05	ELECTRIC POWER SUPPLY SYSTEM
IV:I-06	PROCESS CONNECTION PIPING
IV:I-07	INSTRUMENTATION AND POWER SUPPLY CABLE
IV:I-08	CONTROL VALVES, ACTUATORS & ACCESSORIES
IV:I-09	CONTROL AND INSTRUMENTATIONS FOR PLANT AUXILIARY SYSTEM
IV:I-10	TYPE TEST REQUIREMENTS
IV:I-11	PLANT PERFORMANCE ANALYSIS, DIAGNOSIS & OPTIMISATION SOFTWARE

SUB SECTION – IV:I-01

BASIC DESIGN CRITERIA

SUB SECTION – IV:I-02

DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)

SUB SECTION – IV:I-03

SG RELATED CONTROL AND INSTRUMENTATION SYSTEM

SUB SECTION – IV:I-04

MEASURING INSTRUMENTATION

(PRIMARY AND SECONDARY)

SUB SECTION – IV:I-05

ELECTRIC POWER SUPPLY SYSTEM

SUB SECTION – IV:I-06

PROCESS CONNECTION PIPING

SUB SECTION – IV:I-07

INSTRUMENTATION AND POWER SUPPLY CABLES

SUB SECTION – IV:I-08

CONTROL VALVES, ACTUATORS & ACCESSORIES

SUB SECTION – IV:I-09

CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS

SUB SECTION – IV:I-10

TYPE TEST REQUIREMENTS

SUB SECTION – IV:I-11

PLANT PERFORMANCE ANALYSIS, DIAGNOSIS & OPTIMISATION SOFTWARE

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	BASIC DESIGN CRITERIA			
1.00.00	GENERAL REQUIREMENTS			
1.01.00	The Contractor shall provide Independent SG Control & Instrumentation system, which is Distributed Digital Control, Monitoring and Information System (DDCMIS) based, associated Primary and Secondary Instruments, Panels, LIE/LIRs, Control Valves and Actuators, Process Connection and Piping, Electric Power Supply System, Electrical Actuators, Plant performance Analysis, Diagnosis & Optimisation System (PADO),associated Instrumentation Cables etc. as identified in the specification.			
1.02.00	The Contractor shall provide all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. This work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force.			
1.03.00	Further Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the Bidder and for meeting the intent and requirements of the specification.			
1.04.00	It is to be noted that where equipment or system for the generating units are described, it shall be understood that the quantities described are to be provided per unit basis, i.e., identical sets to be furnished by the Contractor for each of the units unless specifically indicated otherwise. Where equipment or systems for plant common facilities are described, it will be understood that the quantities described are the total quantities required. Wherever quantity has been specified as on as required basis, the same is to be supplied by the contractor on as required basis by the contractor within his quoted lump sum price.			
1.05.00	Bidder shall include in his bid a detailed Bill of Material (BOM) for each of the systems.			
1.06.00	In addition to requirements specified under this Section-VI, Part-B, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.			
2.00.00	PROVENNESS CRITERIA			
2.01.00	Provenness of Supplier: The various C&I equipment shall be from established sources i.e. The supplier for any particular type of equipment/system should have equipment /system manufactured by him and under successful operation in a Power Plant for not less than 2 years.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-01 BASIC DESIGN CRITERIA PAGE 1 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.01.01	Provenness of offered system: Equipment, system, instrument being offered by the bidder comprising of SG C&I System and their MMI system and other associated systems shall be as elaborated in Sub-Section-I, Part-A, Section-VI of Technical Specifications.			
3.00.00	RELIABILITY AND AVAILABILITY			
3.01.00	Each component and system offered by the Bidder shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Bidder, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete C&I system is assured for 99.7%.			
3.02.00	The Bidder shall submit detailed reliability calculations for each system/equipment which (with the help of a schematic of various sub-system connected in series or in parallel as the case may be and MTBF & MTTR values for the various equipments) shall show that availability calculation is as per IEEE Standard - P 1046 or equivalent. Bidder shall submit this along with bid.			
3.03.00	When more than one device uses the same measurement or control signal, the transmitter and other components/ module shall be fully equipped to provide all signal requirements. All the 4-20 mA output signals from transmitters/other control system shall be able to drive minimum 500 Ohms load resistance. The system shall be arranged 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.			
3.04.00	To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criteria mentioned above. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.			
4.00.00	STANDARDISATION AND UNIFORMITY OF HARDWARE			
4.01.00	To ensure smooth and optimal maintenance easy interchangeability and efficient spare parts management of various C&I instruments/equipment like all 4-20mA electronic transmitters/ transducers, control hardware, control valves, actuators and other instruments/ local devices etc. being furnished by the Bidder for main plant areas and other plant and station auxiliaries for similar applications, the Bidder shall ensure that they are of the same make, series and family of hardware.			
5.00.00	OPERABILITY & MAINTAINABILITY			
5.01.00	The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimised.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-01 BASIC DESIGN CRITERIA	PAGE 2 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.02.00	The types of failure that shall be taken into account for ensuring operability of the plant shall include but not be limited to: — Failure of sensor or transmitter. — Failure of main and/or redundant controller/other modules. — Loss of motive power to final control element. — Loss of control power. — Loss of instrument air.			
5.03.00	The choice of hardware shall also take into account sound maintainability principles and techniques. The same shall include but shall not be limited to the following: — Standardization of parts. — Minimum use of special tools. — Grouping of functions. — Interchangeability. — Malfunction identification facility/self surveillance facility. — Easy modular replacement. — Fool proof design providing proper identification and other features to preclude improper mounting and installation. — Appropriate de-rating of electronic components and parts.			
5.04.00	The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.			
6.00.00	UNIT CONTROL & MONITORING PHILOSOPHY			
6.01.00	The Control & Monitoring philosophy envisages control from two locations (a.) From Central Control Room (CCR) (b.) From Local control stations for off site & ancillary plants			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-01 BASIC DESIGN CRITERIA	PAGE 3 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC	
6.02.00	Back-Up Instrumentation Minimum back up of instrumentation to be provided by Employer as specified in Appendix-I to SG C&I and Contractor shall provide hardware of I/O modules for the same .					
7.00.00	ENVIRONMENTAL CONDITIONS					
7.01.00	Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.					
	Ambient Temperature (outside cabinets)	Pressure	Relative humidity	Atmosphere	Required protection Class of panels/ cabinets/ desks to be provided by contractor.	
	Outdoor Location					
	55 degree C max.	Atmosphere	100 % Max.	Air (dirty)	IP 55	
	4 degree C min.	Atmosphere	5 % min.	Air (dirty)	IP 55	
	Indoor Location					
	55 degree C max.	Atmosphere	95 % Max.	Air	IP 54**	
	4 degree C min.	Atmosphere	5 % min.	Air	IP 54**	
	Air Conditioned Areas					
	24 +/- 5 degree C normal	Atmosphere	95 % Max.	Air	IP 22***	
	50 degree C max. *	Atmosphere	5 %min.	Air	IP 22***	
	* During air conditioning failure.					
	** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42.					
	***With a suitable canopy at the top to prevent ingress of dripping water.					
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-01 BASIC DESIGN CRITERIA		PAGE 4 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00	For hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location.			
	PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg.C. For LVS, maximum temperature limit shall be 25 Deg.C and for mini-UPS, the same shall be 40 Deg.C. GROUNDING SYSTEM All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable). Shield on instrumentation cables shall be grounded on panel side. When shielding termination is required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground. System and shield ground shall be connected to Employer provided earthing strip at 0.0 meter level using suitable size of cable to be provided by the Employer. Bidder shall refer Drawing. no. 4610-101-POI-A-021. The Contractor shall submit with the offer recommended grounding scheme required for his system. The exact grounding scheme shall be finalised during detailed engineering.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-01 BASIC DESIGN CRITERIA	PAGE 5 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
1.00.00 1.01.00 1.01.01 1.02.00 1.02.01 1.02.02 1.02.03 1.02.04 1.02.05 1.02.06 1.02.07 1.03.00 1.03.01 1.04.00 1.04.01	DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM DISTRIBUTED DIGITAL CONTROL, MONITORING AND INFORMATION SYSTEM (DDCMIS) General Requirements The requirements for Distributed Digital Control Monitoring and Information System (DDCMIS) are indicated on functional basis in this specification. Contractor shall be responsible for engineering, selection and connection of all components and sub-systems to form a complete system whose performance is in accordance with functional, hardware, parametric and other requirements of this specifications. It not the intent or purpose of this specification to specify all individual system components since the Contractor has full responsibility for engineering and furnishing of a complete system. System Configuration DDCMIS shall basically consist of Control System of Boiler (namely SG-C&I including its Measurement system). Man-Machine Interface and Plant Information System (MMIPIS) System Programming & Documentation Facility DATA COMMUNICATION SYSTEM (DCS) The basic configuration of DDCMIS shall be as indicated in the DDCMIS configuration drawing No.4610-101 -POI-A-001. Contract Quantities of SG C&I System shall be as per Appendix-I to Control & Instrumentation systems. System Expandability Modular System design shall be adopted to facilitate easy system expansion. The system shall have the capability and facility for expansion through the addition of controller modules, I/O cards, peripherals like Large Video Screen (LVS), operator workstations (OWS), printers etc., while the existing system is fully operational. The system shall have the capability to add any new control loops, groups/subgroups in control system, while the existing system is fully operational. On Line Maintenance It shall be possible to remove/replace various modules online (like I/O module, interface module etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing	
	BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2
	SUB-SECTION-IV:I-02 DDCMIS	PAGE 1 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	so, undefined signaling and releases do not occur and controller operation in any way is not affected (including any control loop trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules etc. shall in no way jeopardise safety of plant and personnel.			
1.05.00	Fault Diagnostics			
1.05.01	The DDCMIS shall include on-line self-surveillance, monitoring and diagnostic facility so that a failure/malfunction can be diagnosed automatically down to the level of individual channels of modules giving the details of the fault on the programmer station monitor and printers. The faults to be reported shall also include fault in main & standby power supplies, sensor fault, Controller fault, any channel fault in 2V3 channels, failure of links to other system's DDCMIS, LAN, TG C&I etc. These faults and Controller faults shall be reported as color change on system status display and messages on programmer monitor/ LVS/ OWS as well as through local indication on the faulty channel/ module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place. Failure of any I/O modules, Controller etc. shall be suitably grouped and annunciated to LVS/OWS. In case the faults are not acknowledged / rectified within certain interval, then the same shall be reported to predefined users through messaging system described subsequently in this subsection. The exact strategy of the messaging system shall be elaborated and finalised during detailed engineering.			
1.06.00	Fault Tolerance & Controllability			
1.06.01	The DDCMIS shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized. Control System shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuits/short circuits, instrument air supply failure etc. On any of these failures the control system output shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalized during detailed engineering. System shall be designed such that there will be no upset when Power is restored.			
1.06.02	The system shall be designed to permit the operator to supplement but not inhibit the protective functions.			
1.06.03	The control system furnished by the Contractor shall be designed to be compatible with the Steam Generating Unit, plant auxiliaries and other systems of the Employer. During transient conditions, causing deviations of a process variable, the control system furnished under this specification shall not permit deviations, which exceed those permitted by manufacturers of the main plant equipment.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.04	The control system furnished under this specification shall not inhibit a greater capacity output than the rated capacity of the unit, if permitted by the main plant equipment and required by the Employer.			
1.06.05	The controlled variable response rate & controllability shall be limited by the characteristics of main equipment, which is being controlled, and DDCMIS shall not impose any limitations in the response rate or controllability. Controlled process variables shall return to normal values in a stable manner and without control loop interactions or cycling of generation when generation matches with load demand.			
1.06.06	No single failure either of equipment or power source shall be capable of rendering any part/system/sub-system of DDCMIS inoperative to any degree or loss of generation.			
1.06.07	The system design shall ensure that no single failure, whatsoever in any part of DDCMIS result in loss of communication. The Contractor shall clearly bring out in his offer as to how this requirement is being met in his offered system. Also, the redundancy in HMIPIS, I/O modules & other hardware shall meet the requirements specified elsewhere in this Sub-Section.			
1.07.00	DDCMIS shall meet all requirements stipulated under other Sub-sections/sections of the specification including relevant Sub-Sections of Part-A, (including the requirement Authorization to shipment test ATST) Quality assurance (relevant sub-sections, Section VI of technical specifications) & General Technical Requirements (Part C Section VI of Technical Specifications).			
1.08.00	Signal Exchange 1. For all equipments/devices/drives which are under Contractor's scope of supply and are to be controlled though Station C&I Package System, Contractor shall provide all required signals as required for successful implementation of Closed Loop Control System (CLCS) and for sequence, interlock and protection functions of Open Loop Control System (OLCS) and also the signals required from Contractor's Plant auxiliaries C&I systems for various functions like logs, performance calculations, displays, etc. 2. a. For OLCS, CLCS of BOP C&I part of DDCMIS of Station C&I package as well as SOE requirements; Contractor shall provide galvanically isolated 4-20 mA DC output & potential free contacts. (The contacts shall be rated for not less than 60 V DC and 6 VA). b. In addition to above, The Contractor shall provide two nos. OPC compatible proven two-way communication links through suitable interface between HMIPIS of this package and HMI of Station C&I package of respective units for signals required for information and control purposes. Other methodology shall also be acceptable subject to Employer's approval. The contractor shall provide a proven and reliable data link for two-way transfer of signals (both for information			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-02 DDCMIS PAGE 3 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	and control) between Contractor's DDCMIS and Station C&I package. The Contractor shall provide all necessary hardware and software and shall interact with Employer /Other System Vendor for achieving the data highway link, take the sole responsibility to make the data highway line work satisfactorily. The implementation of the same shall be subject to Employer's approval during detailed engineering. In case it is established that a proven and reliable data highway link is not possible for signal link between Contractor's DDCMIS and Station C&I Package Control System, the same shall be implemented through hardwired signal exchange. 3. For interfacing with SWGR and MCC etc, Contractor shall furnish redundant output modules suitably rated (3 VA) to drive the coupling relays under SWGR /MCC Packages. 4. Contractor shall provide power units/power amplifiers etc. to accept 4-20 mA signals for actuators of PA Fans, FD Fans, and ID Fans, Vanes/Blade pitch control / Variable Frequency Drive etc. The feedback/ position feedback signals from these systems shall be able to drive a load impedance of 500 Ohms minimum. All interfacing and processing cards like galvanic isolation, signal conditioning cards etc for all such signals shall be provided by the Contractor. 1.09.00 System Spare Capacity 1.09.01 Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, DDCMIS shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site: 1.09.02 Ten (10) percent spare channels in each of the functional groups for each type of input / output modules fully wired up to marshalling/ field termination cabinet TBs. 1.09.03 Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules shall be provided by the Contractor for future use. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Field Terminal assemblies, PCB/Connectors (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space, distributed proportionally to main population. 1.09.04 HMIPIS shall be provided with capacity to handle at least 1 no. of each type of peripherals/equipments, additionally, like OWS, LVS, printers, PCs etc., over and above already specified, without any additional hardware or software. Further, the coupler/link between HMIPIS and system bus shall be able to handle 25% extra signals over and above all process as well as calculated (at controller level) signals including the tag nos./process variables being acquired from other DDCMIS sub-system through various links meeting the specification requirements, and HMIPIS			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-02 DDCMIS	PAGE 4 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.09.05	database also shall have provision of at least 25% extra points of above mentioned signals.			
1.09.06	Each controller shall have 20% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type mentioned in clause 1.09.01, 1.09.02 & 1.09.03 above, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of controller.			
1.09.07	The Data communication system (including Main system Bus and other bus system) shall have the capacity to handle the additions mentioned above.			
1.10.00	Twenty (20) percent spare relays of each type and rating mounted and wired in relay cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets. In each of the relay cabinets 20% spare terminal blocks shall be provided so that additional relays can be mounted and wired.			
1.11.00	The spare capacity as specified above shall be uniformly distributed throughout all functional groups. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers/ cabinets in the system delivered at site. Further, these additions shall not deteriorate the system parametric requirement like response time / duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement.			
1.12.00	The DDCMIS shall meet system performance and parametric requirements as stipulated under Performance Guarantees under Part-A, Section-VI, Sub-Section-IV of specifications. Also, the Authorization to shipment tests shall be performed in line with the relevant QA subsections of Section-VI.			
2.00.00	It shall be possible to operate any valve or drive belonging to any sub-system from the HMI of any other sub-systems also by a supervisory command through LAN. Such control shall be based on a pre-engineered list and as per pre-predefined priority hierarchy. It will be possible to modify the list at site under Maintenance Engineers/ Administrator's right.			
2.01.00	The Contractor shall implement all necessary logics & selection facility in Control System/HMIPIS for the same with safeguard to prevent multiple operations simultaneously. Status & other signals related to the drive and the selection by any other user shall be made available to other users.			
2.00.00	SYSTEM DESCRIPTION			
2.01.00	The DDCMIS shall include following main systems/Sub-systems. (Also refer DDCMIS Configuration drg. no. 4610-101-POI-A-001). The DDCMIS shall work in full integration and conjunction with field equipment/drives like pumps, motors, valves, actuators, dampers, hydraulic control systems and field instruments to be provided by the Bidder. The DDCMIS hardware (controllers, modules/cards etc.) shall be housed in cabinets located in control equipment room (CER) except for			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	operation interfaces located in Unit Control Desk (UCD) in Central Control Room (CCR).		
2.02.00	CONTROL SYSTEM		
2.02.01	The Control system along with its measurement system shall perform functions of closed loop control, sequence control, interlock & protection of Main Plant and auxiliaries in all regimes of unit operation.		
2.02.02	The measurement system of control system shall perform the functions of signal acquisition, conditioning and signal distribution of various types of inputs/outputs like analog, (4-20 mA DC- either from pressure / DP/ flow / level transmitters, analysers etc. as well as from temperature transmitters for all temperature measurements from thermocouple, RTD to be connected to this system), binary, pulse, digital transmission through serial port, bus connection etc. (from remote I/O etc., Through various industry standard protect including MODBUS/FIELDBUS/PROFIBUS, prefabs freed and Ethernet etc. The inputs, which are required for only information & monitoring purposes, shall be distributed suitably in various groups' plant area-wise.		
2.02.03	The control system hardware (controllers, modules/cards etc.) shall be housed in cabinets located in respective control equipment room (CER) unitised and offsite except for the remote I/O cubicles which shall be located in respective areas.		
2.03.00	Human-Machine Interface and Plant Information System (HMIPIS)		
2.03.01	The HMIPIS shall perform control, monitoring and operation of Main Plant and auxiliaries in all regimes of unit operation, interacting with the Control System. For this, HMIPIS shall primarily perform following functions:		
2.03.02	Operator interface for Control System		
	Plant Supervisory functions like displays, alarm monitoring & reporting, reports & logs, calculations, trend recording, historical and long term data storage & retrieval, etc.		
2.03.03	The Operator Workstation, LVS & printers shall be located in respective Control Rooms (CR), unitised as well as for offsite, and all other devices/peripherals shall be located in the Programmer's Rooms. OWS/PC's & Printers shall be located in respective areas as detailed out in relevant clauses.		
2.04.00	System Programming & Documentation Facility		
2.04.01	The programmer stations shall be provided for On-line configuration & tuning of Control System and On-line program development/modifications in HMIPIS.		
2.04.02	In addition, latest state of the art work-station based system documentation facility shall be provided to retrieve, generate & document all system documentation, logic,		
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	control loops, cable interconnection, etc. to achieve paperless documentation for the complete plant			
2.04.03	The programmer stations shall be located in the programmer's room.			
2.05.00	DATA COMMUNICATION SYSTEM (DCS) The Data Communication System shall be provided for communication between Control System and HMIPIS, communication & signal exchange between various functional groups as well as communication between various units & off site / off line systems			
2.06.00	Annunciation System The annunciation logic will be implemented as a part of DDCMIS and annunciation shall be made available on all OWS/LVS.			
3.00.00	MEASUREMENT FUNCTIONS OF CONTROL SYSTEM			
3.01.00	All the signals coming into/going out of the Control System shall be connected either directly or routed through marshalling cabinets as detailed out in the interconnection philosophy of DDCMIS as given in Sub-section: Instrumentation cables, Part B, Section VI A of technical specifications. The input / output modules employed in the Control System shall be separate from controller hardware.			
3.01.01	The functions listed below shall generally be performed in I/O modules; however, some of the functions can be implemented in the controllers.			
3.02.00	Analog signal conditioning & processing			
3.02.01	The conditioning and processing functions to be performed as a minimum for the analog inputs coming for control and information purposes are: 1. : Galvanic isolation of input and output signals for which power supply source is other than the measurement system of the control system. 2. : Transmitter power supply with per point fuse protection or current limiting and power supply monitoring. 3. : Transducer/transmitter signal output limit check 4. : Implementation of multiple measurement schemes 5. : Square root extraction 6. : Pressure and temperature compensation. 7. : On-line ADC gain and drift monitoring and correction at periodic intervals.			
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3.02.02	8. : Linearisation of temperature signals (from thermocouple & RTD through temperature transmitters). 9. : Reasonability checks for all analog inputs. 10. : Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop as finalized during detailed engineering stage. (This will include blocking of trip signals in case of RTD failure). 11. : Rate of Rise / Fall calculation. 12. : LVM Generation.			
	All analog signals for control purpose shall be acquired, validated, processed and their respective Controller data base updated at a maximum interval of 250 milli seconds except for some fast-acting control loops for which the above-referred time shall be as per process requirement. The corresponding time for temperature signals can be up to 1.5-2 secs. For signals required for information only, the above functions shall be performed at an interval of 1 second. The HMI database updation shall not take more than one (1) second. The validated analog inputs shall be converted into engineering units on a per point basis. Analog input processing (scanning to alarm checking) shall be performed once every scan cycle. It shall be possible to delete any analog input from scan or to return it to scan on demand by the operator.			
3.02.03	The analog 4-20 mA input cards shall have input loop resistance ≥ 250 ohm for interfacing transmitters/analysers giving 4-20mA analog signal along with superimposed HART interface signals. 4-20 mA DC signals will only be used for control purpose and superimposed HART signal will be used for configuration, maintenance, diagnostic and record keeping facility for electronic transmitters and analysers etc.			
3.03.00	Binary signal conditioning & processing			
3.03.01	The changeover type contacts (i.e. 'NC' + 'NO' together) shall be wired to the Control system for all the binary inputs required for control purposes, except for inputs from MCC/SWGR, limit switches of electrical actuators with integral starters, pneumatic actuators not used in protection function and inputs related to hardwired signal exchange among various functional group for which non-changeover type Contact ('NC' or 'NO') shall be wired to the Control System. The binary inputs required for information purposes only shall be wired to Control system in the form of non-changeover type contacts.			
3.03.02	The conditioning and processing functions to be performed as a minimum for the binary inputs coming for control and information purposes are:			
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	1 : 24 VDC power supply for contact interrogation for all potential free contacts with per point fuse protection or suitable current limit feature/ isolation through opto-coupler. 2 : Contact bounce filtering delay time of 15 milliseconds.. 3 : Facility for automatic pegging the binary signal to logic one/zero or last correct value in case of failure of binary input module. 4 : Binary signal distribution to different user shall be in such a way so as to ensure that a short/ground fault on one user is not reflected to the other user. 5 : Implementation of multiple measurement schemes for signals for control purpose. 6 : All binary signals shall be acquired validated, processed, alarm checked and their data base updated within one second. 7 : Checking for excessive number of status changes for all binary/contact inputs and making it off-scan, if the total no. of changes exceeds a limit within pre-defined time. The HMI buffers should not be saturated due to a chattering contact. 8 : Facility to delete any binary input from scan or to return to scan on operator demand. 9 : The non-coincidence monitoring shall be provided for binary inputs for all changeover signals. 3.04.00 Triple measurement scheme Triple measurement scheme for analog inputs employing three independent transmitters connected to separate tapping points shall be employed for the most critical measurements. The three signals shall be auctioneered to determine the median/average value, which will be used for control purpose. In case one transmitter fails or shows excessive deviation with respect to others, it will be removed from computation of median/average value & the average of the other two transmitter outputs shall be used for controls. The control loop shall trip to manual when any two of the three transmitter signals fail. The operator shall be able to select any of the transmitters or the median/average value from the LVS/OWS. The outputs of the transmitters shall be continuously monitored for excessive deviation which shall be displayed, logged & alarmed. 3.04.01 Individual transmitter signals their status and selected value for control/ measurement and shall be available on LVS/OWS.			
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3.05.00	Dual measurement scheme Dual measurement scheme for analog inputs employing two independent transmitters, connected to separate tapping points/ temperature element shall be employed for the remaining measurements used for analog control functions.			
3.05.01	The output of the redundant transmitters shall be continuously monitored for excessive deviation. In case the deviation is within limits, the mean value shall be used for the control loop. If the deviation becomes high (with both transmitters remaining healthy), the loop will be automatically transferred to manual. However, if one transmitter fails and the other transmitter remains healthy, then the output of the healthy transmitter shall be used for control. If the other transmitter also fails, loop shall trip to manual. The operator shall be able to select any of the transmitters or the mean value from the LVS/OWS. The outputs of the transmitters shall be continuously monitored for excessive operation which shall be displayed and logged and alarmed.			
3.05.02	Individual transmitter signal, their status and selected value for control/measurement shall be available on LVS/OWS.			
3.06.00	The measurement system of control system should be capable of acquiring data from various equipment & system in digital form through serial port, field bus / profibus, Ethernet connection using industry standard protocols. The control system shall include requisite modules for accepting such signals examples of such signals will be from remote I/O signals (through extended I/O bus), field bus/profibus type temperature transmitters, Electrical Power Supply System etc.			
3.07.00	Wiring Scheme for inputs to control system shall be as follows:			
3.07.01	Each of the triple redundant binary & analog inputs shall be wired to three separate input modules. In addition, for functions employing 2V3 controllers (eg. BMS, protection), each of the redundant binary & analog signals shall be wired to separate input modules associated with each controller. Similarly each of the dual redundant binary & analog inputs shall be wired to two separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group. No single failure in any component of the control system shall lead to unavailability of more than one of dual/triple redundant input signals to control system. Similarly, no single failure in any component of the control system shall lead to unavailability of more than one of dual/triple redundant Output signals from the control system.			
3.07.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:			
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	i. The on-off status of HT drives and synch type breakers shall be wired to two input modules in parallel. ii. All single analog & binary inputs including the limit switches of valves/dampers/ MCC/SWGR, check-backs of all drives, SOE & information related signals shall be wired to single (i.e. non-redundant) input modules.																				
3.08.00	The binary and analog outputs from one subsystem of the Control System to other which are required in these systems for control purposes, (only very few critical signals e.g., Reheater Protection, MFT etc.), shall be made available from triple/dual redundant binary and analog output modules. Other binary & analog outputs shall be non-redundant only. Failure of any single module shall not affect operation of more than one single drive.																				
3.09.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.																				
3.10.00	The maximum number of inputs/outputs to be connected to each type of module shall be as follows: <table><tr><td>1</td><td>: Analog input module</td><td>16</td></tr><tr><td>2</td><td>: Analog output module</td><td>16</td></tr><tr><td>3</td><td>: Binary input module</td><td>32</td></tr><tr><td>4</td><td>: Binary output module</td><td>32</td></tr><tr><td>5</td><td>: Analog input & output (combined)</td><td>16</td></tr><tr><td>6</td><td>: Binary input and output (combined)</td><td>32</td></tr></table> Note: For binary inputs, one changeover contact is counted as 2 inputs.			1	: Analog input module	16	2	: Analog output module	16	3	: Binary input module	32	4	: Binary output module	32	5	: Analog input & output (combined)	16	6	: Binary input and output (combined)	32
1	: Analog input module	16																			
2	: Analog output module	16																			
3	: Binary input module	32																			
4	: Binary output module	32																			
5	: Analog input & output (combined)	16																			
6	: Binary input and output (combined)	32																			
3.11.00	The following requirements shall be met for analog/binary input/output modules as applicable.																				
3.11.01	Input filters to attenuate noise shall be provided.																				
3.11.02	All analog/binary inputs and outputs shall be capable of withstanding 500V DC common mode and 500 V AC peak to peak between analog and digital parts. All analog outputs shall be short circuit proof.																				
3.12.00	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station Monitors for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be logged and displayed.																				
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4.00.00	CONTROL SYSTEM REQUIREMENTS			
4.01.00	The control system shall be broadly divided into the following control system:- Control System of Boiler (namely SG-C&I including its Measurement system).			
4.01.01	The SG C&I system shall perform mainly the following: (i). Burner Management System (BMS) including control & protection of coal Mills along with Mill lube Oil pumps and other associated drives, Fuel oil system including signal processing etc. (ii). Analog control Functions pertaining to separator drain contro (for once through Boiler), Secondary Air damper control, Aux PRDS press & temp Control, atomising steam/air pressure controls, Fuel Oil Header Pressure/Flow control etc. (iii). Soot Blower Control. (Including SB steam pressure and drain temperature control). (iv). Mill Fire Protection etc (v). Mill Reject System, Boiler Drain and Vent valves including Start up drains and vents. (vi). Other Miscellaneous Controls, Boiler Metal Temperature Measurements, Signal Processing Etc. The functional grouping shall be as per drawing no. 4610-101-POI-A-009.			
4.01.02	The numbers of Functional Groups (FGs) which have been indicated in the above drawings are the minimum required. For each of the FGs, separate sets of controllers, I/O modules, communication controllers, power packs/ modules, etc. shall be provided. Mixing of hardware of two or more FGs shall not be acceptable. However, splitting of any functional group in more than one FGs due to any limitation in Bidder's system (e.g. limitation in handling number of inputs/outputs including spare capacity, limitation in implementation of number of functional blocks including spare blocks etc.) shall be acceptable, subject to Employer's approval. It may be noted that after splitting of the functional groups, each FG must have its own set of controllers, I/O modules, communication controllers, power packs/modules etc. It shall be ensured that failure of any set(s) of hardware of any FG does not affect other FG(s) and data communication between other FG(s) and HMIPIS.			
4.01.03	The minimum functions to be realized in each of the above mentioned Control Systems shall be as per requirements specified under subsequent clauses of this specifications. The Contractor shall provide all hardware/software, whether or not specifically indicated in this specification to fully meet operational/ maintenance/ safety requirement as well as statutory/international standard and proven practices.			
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4.01.04	The Control System shall function reliably under the environmental conditions as specified in of Sub-Section:-Basic Design Criteria of this specification. It shall be immune from the interference resulting from disturbances in power supply feeders, signal lines, inputs, outputs, etc. as experienced in a coal fired power station.			
4.01.05	The Control System shall have on-line simulation & testing facility. Further, it shall be possible to on-line configure & tune controllers through programmer station.			
4.01.06	The system shall have the flexibility to easily reconfigure any controller at any time without requiring additional hardware or system wiring changes and without disabling other devices from their normal operation mode. Modifications shall not require switching off power to any part of the system.			
4.01.07	Power supply to individual functional group shall be from redundant 24V feeders with diode auctioneering and further sub-distribution.			
4.01.08	The assignment of I/O channels for Inputs/Outputs, arrangement of modules within cabinet etc. shall be identical for all units except those inputs/outputs which are common for all units. Further uniformity should be maintained for redundant stream of process equipment within a unit.			
4.01.09	The application programs for the functional controllers shall be software based which shall be maintained even through power supply failure. The application program shall be alterable through the configuration and tuning station for all configuration and strategy changes, etc., and through the operator's console for set point/bias changes, device selection, etc. Parts replacement or parts removal shall not be required in order to accomplish changes in application programs including system tuning. In case it is Contractor's standard practice to have the application programs also firmware based (i.e. EPROM / EEPROM), then the same is also acceptable. However, in that case, Contractor shall provide necessary programming device including EPROM Writer/eraser etc. (2 Nos. per unit)			
4.01.10	Independent and dedicated controllers (main and its 100% standby) shall be provided for each of the functional group (FG) of Control System except for the cases where triple redundant controllers are to be used as per this specifications. All the 100% hot/redundant backup controllers shall be identical in hardware and software implementation to their corresponding main controllers and shall be able to perform all its tasks. The backup controller shall track its corresponding main controller. There shall be an automatic and bump less switchover from the main controller to its corresponding backup controller in case of main controller failure and vice versa without resulting in any change in control status. In case of switchover from main controller to the 100% hot backup controller, the back-up controller shall work as the main controller. Facility shall also be provided for manual switchover from main to 100% hot back-up controller and vice versa from the programmer's station.			
4.01.11	The control system hardware design shall be such that it is able to withstand power line disturbances.			
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4.01.12	The loop/logic reaction time shall be suitable to match actual process requirements, subject to minimum requirement wherever specified.			
4.01.13	The C&I system sub-supplier / manufacturer shall prepare the logic & loop diagrams based on the recommendations of the main equipment manufacturer (e.g. Boiler Turbine and other Major equipment manufacturer, as applicable) keeping in view latest engineering practices. The respective main equipment manufacturer shall vet these loop and logic diagrams including the set values. This shall be applicable to the SG-C&I system only including the BMS, Start Up Control System (for once through Boilers), etc.			
4.02.00	Burner Management System (BMS) 1. Fully proven microprocessor based system, based on hardware and software specifically designed and proven for Burner Management application meeting the proven ness criteria specified in Subsection I , Part B, section VI shall be provided to achieve the Boiler protection action e.g. master fuel trip (MFT), control of mills & fuel oil systems etc. 2 The BMS shall be provided with automatic self-monitoring facility. All modules to be used in this system shall be of fail safe design. Any single fault either in primary sensor, I/O modules, multifunction controllers, etc. should not result in loss of safety function. All faults should be annunciated to the operator right at the time of its occurrence and also for alarm annunciation facia. The BMS shall meet all applicable relevant safety requirements including those stipulated in latest editions of VDE 0116, Section 8.7, VDE 0160, NFPA 85 etc. Bidder shall certify compliance for already implemented MFT proposed for this project to VDE 0116, Section 8.7, VDE 0160 safety standards. The configuration of the MFT sub-group of BMS to be provided shall be as indicated in the drawing no. 0000-999-POI-A-002. The exact implementation shall be subject to Employer's approval during detailed engineering. 3. The MFT functions shall be implemented in a fault tolerant 2 out of 3 triple redundant configuration. Each of the three independent channels shall have its own dedicated processors, multifunction controllers, communication controllers, I/O modules, interface etc. All safety related process inputs shall be fed to each of the 3 channels. All the primary sensors for unit/boiler protection shall be triple redundant. Additional signal for each trip input shall be made available for 1ms resolution SERS (Sequence of Event Recording System) (In Employer's Scope) at the input level itself, without any processing so as to enable analysis in sequence of event, the exact cause of trip.			
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	4. The acquisition and conditioning of binary and analog protection criteria signals for MFT shall be carried out in each of the three triple redundant channels. Each channel shall compute the 2 out of 3 voting logic and issue a trip command. The trip signals of the three channels shall be fed to a fail safe 2 out of 3 relay tripping unit for each drive. The protection criteria for tripping shall be executed by a program which shall be identical in each of the triple redundant channel. The check back contact signals of each relay of the 2 out of 3 relay tripping unit shall be fed back to each of the triple redundant channels and shall be continuously monitored for equivalence in each of them. (Refer Drg. No. 0000-999-POI-A-002). In case one of the independent channels or any of the triple redundant sensors is faulty, the same shall be alarmed and the balance two channels/sensors shall operated in one out of the two modes. 5. The functionality of operation of mills, oil etc. shall be similar to that of OLCS as described later in this Subsection. 6. The BMS shall be designed to : - Prevent any fuel firing unless a satisfactory purge sequence has first been completed. - Prevent start-up of individual fuel firing equipment unless permissive interlocks have first been satisfied. - Monitor and control proper equipment sequencing during its start-up and shutdown. - Provide equipment status feed back and annunciator indication to the unit operator. - Provide flame monitoring when fuel-firing equipment is in service and effect a burner trip or master fuel trip upon warranted firing conditions. - Continually monitor boiler conditions and actuate a master fuel trip (MFT) during adverse operating conditions which could be hazardous to equipment and personnel. - Reliably operates and minimize the number of false trips. - Provide a master fuel trip relay independent of processors and I/O modules to provide a completely independent trip path. - Provide all logic and safety interlocks in accordance with National Fire Protection Association (NFPA).		
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	- Include a first out feature in all controllers to identify the cause of any burner trip or boiler trip. - Provide a complete BMS diagnostic system to immediately identify to the operator any system module failure. - Allow burners and igniters to be started, stopped and tripped on a burner basis. - Allow the automatic start and stop of burners based on boiler load. The sequence of which burner will be started or stopped will be selected by the operator from a OWS/LVS display.			
4.03.00	Binary Controls/Open Loop Control System (OLCS) Functions			
4.03.01	These clauses are applicable for all the Binary controls of DDCMIS included in Contractor's Scope including Soot Blower Control System (Where specific requirements for protection systems, Burner Management System (BMS) have been indicated, the same will govern)			
4.03.02	The OLCS shall include sequence control, interlock & protection for various plant auxiliaries/valves/dampers/drives etc. The sequence control shall provide safe and automatic startup and shutdown of plant and of plant items associated with a plant group. The interlock and protection system shall ensure safe operation of plant/plant items at all times and shall automatically shut down plant/plant items when unsafe conditions arise.			
4.03.03	The OLCS shall be arranged in the hierarchical control structure consisting of unit level, group level, subgroup level & drive level (as applicable).			
4.03.04	It shall be possible to perform automatic unit startup & shutdown by issuing minimum number of command from LVS/OWS. Thus, the unit level shall control all the Control System Blocks and issue appropriate startup & shutdown commands to various blocks of this Control System and also from Station C&I package Control System and receive issue corresponding commands/check backs/feedbacks.			
4.03.05	The group level shall control a set of functional sub-groups of drives. Appropriate start-up and shut down commands shall be issued to the sub-group control and various check-backs shall be received from sub-groups or drives. Each sub-group shall execute the sequential start-up and shut down programs of a set of inter-related drives along with system interlocks and protections associated with that sub-group as well as basic interlocks and protections related to individual drive falling under that sub-group. The drive level shall accept commands from the sub-groups, push buttons (wherever provided), etc., and transmit them to the respective drive, after taking into account various interlocks and protections and the safety of that particular drive. For HT drive, first-up logic shall be incorporated to indicate the cause of protection/trip.			
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4.03.06	Sequence Control			
	1 A sequence shall be used to move a set of groups, sub-groups from an initial steady state (for instance 'OFF') to a final steady state (for instance 'ON'). The sequence initiating command for the unit & group level shall be issued from LVS/OWS. 2 A sequence shall be made of steps. The steps shall be executed in predetermined order according to logic criteria and monitoring time consisting of the interlock & protection requirements and check back of previous step which shall act as preconditions before the sequence control can execute the command for that step. 3 Each step shall have a "waiting time" implying that the subsequent step would not be executed unless the specified time elapses. A monitoring time shall also be defined as the maximum time required in executing the commands of any step and the time required for appearance of check back signals. In case, this is not completed within the specified time, a message shall be displayed and programme will not proceed further. 4 Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the programme on return to automatic control. Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands. 5 Open or close priority shall be selectable for each drive. 6 The sequence startup mode shall be of the following types. a Automatic Mode In this mode of operation, the sequence shall progress without involving any action from the operator. The sequence start/stop command shall be issued from the LVS/OWS. b Semi-Automatic Mode In this mode of operation, once the sequence is initialised, the step progressing shall be displayed on the OWS/LVS. But the step execution command shall be prevented and shall be sent by the operator via the keyboards. It shall be possible to bypass and/ or simulate one or more criteria to enable the program to proceed. This facility shall allow the program to be executed even if some criteria are not fulfilled because of defective switching device, etc., while the plant condition is satisfactory. All the criteria bypassed shall be logged and displayed. It shall be possible to put the system on the Auto-mode after operating it on semi-automatic mode for some steps or vice-versa, without disturbance to the sequence operation.			
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	c Operator Guide Mode / Test Mode It shall be possible to use the sequential control in operator guide mode/ test mode i.e. the complete system runs and receives input from the plant and the individual push button stations (where provided)/ keyboards but its command output is blocked. The whole programme, in this case shall run in manual mode. This mode shall allow the operator to practice manual operation using step and criteria indications. The actual protection should remain valid during this mode of operation also. 4.03.07 The sequence shall be started by putting the sequence on 'auto' and on receipt of 'start' command from the LVS/OWS or from a higher-level group/ protection action as defined. The sequence shall then progress as per the defined logics. It should be possible to select alternative operation in the same sequence depending on certain process/ equipment condition. Some step can be automatically bypassed also based on certain process/ equipment condition. When the expected results of the sequence are reached the sequence is considered as "End". 4.03.08 If during sequence initialization or sequence progressing or during normal running of the drive, a shutdown criterion is present, the sequence shall be stopped and the shut down sequence initiated. 4.03.09 For the drives, the command shall be provided through redundant O/P module to MCC/SWGR/Actuator as applicable and inputs (status, SWGR & process) shall be acquired through input modules. The failure of one of the redundant output module shall in no way affect the function of the other output module. 4.03.10 The output modules control module shall have the feature that ensures that in case of failure, all the outputs are driven to zero. The 24V DC command outputs to drives for ON/OPEN, OFF/CLOSE shall be separate and independent and inverted outputs shall not be employed. Keeping +24 V Dc extended to the relays for these outputs continuously and extending ground/ negative when command is to be issued is not acceptable except some of the auxiliary plants as to be decided during detailed engineering. 4.03.11 For inching type of drives, position transmitter power supply and monitoring of position transmitter signal shall be provided. 4.03.12 The termination for OPEN (ON)/CLOSE (OFF) command for the drive actuator shall be performed in the actuators specified elsewhere in the specification. However, OPEN (ON)/CLOSE (OFF) and disturbance status as a minimum shall be monitored in OLCS. 4.03.13 The sequence interlock & protection requirements shall be finalized during detailed engineering and the same shall be subject to Employer's approval.			
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4.03.14	Drive related inputs and outputs shall be assigned in I/O modules as per pre-defined uniform pattern. The philosophy for the same shall be as approved by the Employer during detailed engineering stage. The interfacing of these outputs with MCC/SWGR/Actuators shall be as per interfacing requirements the system design shall ensure that in case of failure of output module, all the outputs shall be driven to zero. The position indication for inching type valves and push-button wherever provided, shall be interfaced through I/O modules.		
4.03.15	The drive function i.e. basic interlock & protection logic of the drive shall be implemented in redundant controllers. The drive function shall ensure that protection signals for the safety of the drive shall be effective under all conditions and under all modes of operation. The different commands shall be performed according to the priority of protection 'Off', Protection 'On', manual and automatic. The standard functions like running time monitoring, status signaling, alarm/drive annunciation, etc. shall be performed in drive function. The drive function shall prevent hunting of the actuator in the presence of both open & close commands for actuators of the valves & dampers. The drive function shall be implemented in dedicated standard software functional block.		
4.03.16	The reversible drives to be controlled under OLCS shall be actuators with integral starters. These actuators will have coupling/interposing relays for accepting commands from OLCS and shall provide check back signals to OLCS. As such, all drive related inputs/outputs for reversible drives shall be available from actuators in field. The 'Open' and 'Closed' limit switches of each actuator shall be monitored with selectable delay time to check & alarm the contradictory condition of both contacts indicating 'Open' or 'Closed' status of actuators. The actuators for valves & dampers shall be interfaced as follows :		
4.03.17	The open/close commands and check back signals from limit switches and disturbance signals shall be hardwired to respective OLCS group through I/O modules from actuators in the field.		
4.03.18	It shall be possible to control all common system drives (i.e. common for more than one units), from all or some of the units. The Contractor shall implement all necessary logics & selection facility in Control System/HMIPIS for the same with safeguard to prevent multiple operations simultaneously. Status & other signals related to the drive and the selection by any other unit shall be made available to each unit HMIPIS system.		
4.03.19	Employer will implement Unit level and group Level sequences as a Part of BOP C&I System of Station C&I package. Contractor shall provide and accept all necessary signals for successful implementation of the same.		
4.04.00	Modulating Controls/Closed Loop Control System (CLCS) Functions		
4.04.01	This Clause is applicable for all analog controls of DDCMIS.		
4.04.02	The CLCS shall continuously act on valves, dampers or other mechanical modulating devices such as hydraulic couplings etc., which alter the plant operation		
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	conditions. The system shall be designed to give stable control action in steady state condition and for load changes in step/ramp over the load range of 60% to 100% MCR with variation or parameters within permissible limits to be finalized during detailed engineering state. The system shall have the following minimum features :			
4.04.03	The controller capability shall, as a minimum, include (i) P, PI, PD and PID control functions and their variations (ii) cascade control (iii) feed forward control (iv) On-Off control, (v) Ratio and bias control, (vi) Logical operation .			
4.04.04	The loop reaction time (from change of output of the transmitter/temperature element to the corresponding control command output) shall be within 500 milli seconds.			
4.04.05	The control loop shall have enough flexibility and various features to perform feed forwards, balancing of controller, increasing the response to achieve the desired process parameter within prescribed time frame. In order to achieve this, the CLCS design shall have features of on-line auto-tuning, i.e. change of proportional sensitivity, integration time etc. depending on load or other process condition.			
4.04.06	The control system shall be bumplessly transferred to manual on the conditions of Control power supply failure, Failure of redundant controllers, Field input signal not available, Analog input exceeding preset value, etc. as a minimum and as finalized during detailed engineering.			
4.04.07	Any switch over from auto to manual, manual to auto and switchover from CRT/ LVS operation to H/A station operation and vice versa shall be bump less and without resulting in any change in the plant regulations and the same shall be reported to the operator and recorded automatically.			
4.04.08	Buffered analog output (positioning signal) of 4-20mADC shall be provided from CLCS to the respective E/P converters. For electrical actuators, pulse type output (bound less control) shall be preferred. CLCS shall also provide all the necessary outputs for indicators & recorders with output loop resistance of 500 ohms for each channel of the output module.			
4.04.09	Contractor shall submit the functional requirement of the CLCS loops as well as the detailed schemes based on their experience in Thermal Power Plant with similar design parameters shall be finalized during detailed engineering stage and shall be subject to Employer's approval.			
4.04.10	The System being supplied shall be such that when permissible limits are exceeded, an automatic switchover from an operation governed by maximum efficiency, to an operation governed by safety and availability is affected.			
4.04.11	For safety reasons, switchover logics associated with the modulating control loops shall be performed within the closed loop control equipment. Modulating control loops shall be provided with standard features to interface overriding commands from OLCS/Protection System like open, protection open etc.			
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4.04.12	Where the equipments are controlled by a group of regulators acting in parallel, the relative position of individual actuator associated with them shall be capable of being adjusted with respect to one another and to the common automatic signal.			
4.04.13	Time supervision facility shall be provided to monitor the final control element.			
4.04.14	It shall be possible to block the controller output on a pre-programmed basis.			
4.04.15	All controllers shall be freely configurable with respect to requisite control algorithms.			
4.04.16	Whenever, alternate measurement is available for a control input the alternate measurement value will be automatically substituted in the control loop in case of loss of control input. All necessary software for switching and reconfiguration shall be provided. In addition, such substitution shall be balance less and bump less and shall be reported to the operator and recorded automatically.			
4.05.00	SADC, AUX. PRDS, SBC SYSTEM			
4.05.01	Secondary Air damper Control System			
	1. SADC system shall be provided to achieve the following functions : - Control of fuel air flow. - Control of auxiliary air flow at the oil elevations. - Control of wind box/furnace differential pressure. - Limit NOX content in the flue gas by modulating over fire dampers, if provided.			
	2. In case of tangentially fired boiler, SADC shall modulate fuel air dampers of each elevations based on the signal that is representative of the coal feed rate. Further, the auxiliary air dampers at the oil elevations shall be modulated on fuel oil pressure signal whereas the auxiliary air dampers at all other elevations shall be modulated to maintain the wind box to furnace differential pressure.			
	3. In order to limit the NOX content in flue gas, SADC shall also include the control of over fire dampers (if provided). The secondary air damper controls and necessary interlocks to modulate or to open/close shall be incorporated as per the requirements of the boiler design.			
	4. The secondary air damper control system shall also be provided even in case front or front and rear fired boiler is offered. All requirements indicated above shall be met by the Contractor. Further Contractor shall provide required secondary air flow devices for measurement of compartmental wind box air flow for each elevation etc.			
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4.05.02	5. Individual position transmitters are to be provided for each of the secondary air dampers and the same shall be connected to SADC Control System. Auxiliary pressure Reducing And De-superheating Station (AUX. PRDS) Control System 1. Auxiliary PRDS control system shall be provided to control the low capacity PRDS (with steam tapping off from CRH line) and the high capacity PRDS (with steam tapping off from MS line) and coordinate their operation under all regimes of unit/plant operation. 2. Each of the aux. PRDS units (i.e. low capacity PRDS and high capacity PRDS) shall be provided with automatic control loops for steam pressure control, steam temperature control and spray water pressure control. However, facility for remote manual control shall also exist in case the automatic control fails. The signals for steam pressure and temperature control shall be taken from the down-streams of pressure reducing valve and de-superheating station respectively and their set points shall be adjustable. The spray water pressure control shall regulate the pressure up-streams to the temperature control valve and also based on feed forward signal from steam temperature control. 4.05.03 Soot Blower Control System (SBCS) 1. Soot Blower Control (SBC) system complete with provision for individual operation of any soot blower and facility to bypass any soot blower shall be provided with following : (i) Automatic starting of each soot blower in the system. (ii) Canceling the operation of any soot blower in the system when required. (iii) Indication of the soot blower-selected to operate. (iv) Capability to monitor all the essentials of the soot blowing system. (v) Capability to prevent continued soot blower operation if the system is not functioning properly. (vi) The ability to operate two soot blowers located in opposite walls simultaneously. (vii) Manual over-riding of the automatic operations.			
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	(viii) To prevent automatic blowing when the parameters of soot blowing system are beyond permissible limits. (ix) Indications of soot blower which has malfunctioned. (x) Control circuit for the retractable blowers shall be so designed as to prevent insertion of the blowers into the combustion chamber unless the blowing medium is available. (XI) Limit switches and Torque switches are to be connected to DDCMIS and command termination shall be done in DDCMIS only for each of the blowers. 2. Soot Blower control system shall also provide controls for : (i) Pressure control of steam (ii) Warm up control of the complete piping system which shall include flow control, drain temperature control etc. (iii) Steam temperature control (if required) 3. Separate and independent hardware shall be provided for soot Blower controls mentioned above. All the above control system shall be implemented in 'SG-C&I' part of DDCMIS.			
5.00.00	HUMAN-MACHINE INTERFACE AND PLANT INFORMATION SYSTEM (HMIPIS) REQUIREMENTS			
5.01.00	General Requirements			
5.01.01	Man-Machine Interface system shall be designed and engineered for safe, efficient, reliable and convenient operation. HMIPIS shall employ high-performance, non-proprietary open system architecture to ensure fast access and response time and compatibility with other system and portability of third party software. HMIPIS shall be used primarily for the following functions: (a.) As operator interface for control operation for the plant for accepting data from and issuing commands to Control system etc. (b.) To perform plant supervisory, monitoring and information functions			
5.01.02	The plant data pertaining to one unit shall be available in the HMIPIS of the respective unit. Data from common system shall be available in the HMIPIS of all units. Further, suitable displays with selection facility shall be provided for common system drives so that all common system drives can be controlled from all or some of the units.			
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5.01.03	No single failure in HMIPIS shall lead to non-availability of more than one OWS or one LVS or one printer. In such an event i.e., single failure leading to non-availability of any OWS/LVS, it shall be possible to operate the entire plant in all regimes of operation including emergency conditions from each of the other available OWS/LVS.			
5.02.00	Operator interface to the Control System			
5.02.01	The operator interface of the HMIPIS shall consist of monitor / Mouse, Keyboards of OWS, large video screen (LVS) (In Employer's Scope), printers, etc.			
5.02.02	The operation shall employ powerful menu-driven and multi-window supported input facilities for operational ease and comfort.			
5.02.03	The following functions shall be provided as a minimum:			
5.02.04	All OWS/LVS of the HMIPIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area on drive shall be possible from any of the OWS/LVS at any point of time without the necessity of any action like downloading of additional files. Each OWS/LVS shall be able to access all control information related data under all operating conditions including a single processor/computer failure in the HMIPIS. Further, simultaneous operation of at least two drives of control system shall be possible from a single display without calling additional displays for multiple drive operation.			
5.02.05	All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions.			
5.02.06	The operator functions for each OWS/LVS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering.			
5.02.07	The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.			
5.02.08	The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as indicated in the			
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	following table and shall be as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator).								
5.02.09	For all the drives common for all/some units, facility shall be provided for control & status monitoring in HMIPIS of each unit. All necessary interface hardware shall be provided by the Contractor to achieve this								
5.02.10	When any drive or sequence is being controlled from a OWS or LVS, the system shall inhibit control access of the same drive or sequence from other OWS or LVS.								
	SI. No	Level	Users	Functions allowed	Functions Prohibited				
	1	Operation	Operators	-Control of Drives/equipments -Viewing of all displays -Changing certain pre-selected parameters like set points, bias etc. -Printing of reports	-Modifications of Control parameters. -Value forcing/pegging. -Modifications of Logics /loops/data base/MMI S/W -Taking points off-scan, changing of assignments of logs & trends etc.				
	2	Supervisory	Unit –In Charge	-Control of Drives/equipments -Viewing of all displays -Changing certain pre-selected parameters like set points, bias etc. -Printing of reports -Taking points off-scan, changing of assignments of logs & trends etc.	-Modifications of Control parameters. -Value forcing/pegging -Modifications of Logics /loops/data base/MMI S/W				
	3	See Note-1	-Shift Incharge -Station Incharge -O&M Incharge -Other PC based Users	-Viewing of all displays -Printing of reports	-Control of Drives/equipments -Modifications of Control parameters. -Value forcing/pegging - Modifications of Logics /loops/data base/MMI S/W - Taking points off-scan, changing of assignments of logs & trends etc				
	4	Maintenance	C&I maintenance in-charge of the control system	-Control of Drives /equipments (during commissioning stage) -Viewing of all	-Control of Drives/equipments (during normal operation stage) -Modification of MMI S/W				
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			displays -Changing all parameters like set points, bias etc. -Printing of reports -Modification of all loops/logics/ database -Value forcing/pegging		
5	Programmer (Administrator)	C&I maintenance in-charge of the control system	-All operator, supervisory & maintenance functions -Modification of HMIPIS Software - System administration - System Backup	NIL	
NOTES:-					
1.	This level, if required, shall be sub-divided into at least four levels during detailed engineering if required to restrict certain type of displays.				
2.	It shall be possible to have many users with Individual user names and password at each level.				
3.	The system shall be flexible to add levels and change user profiles easily at operational stage. This function shall be performed by the Programmer (administrator)				
4.	The access to operating system setting shall be restricted, i.e, by log-in with user levels of Sl. No. 1-4, the OS settings can not be changed.				
5.	On the Operator workstations/LVS control Unit, the OS window will be totally inaccessible (i.e., only the "Operator" window should be present) except with login by Sl. Nos. 4 & 5.				
6.	For operation or programming/configuring/tuning of any particular unit, the physical resource of that unit should be used. To ensure the same, the security system shall allow any user (other than the administrator) access to only the unit on which he is working. Even for the administrator, any such access shall be allowed only after issuing on warning & acceptance of the same. However, viewing purpose through station LAN, no such global restrictions shall be there except for any restriction on the access is provided for administrative/security purpose. The above clause is not applicable for operation of common drives which has been designed to be operated from any unit.				
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5.03.00	Plant Supervisory, Monitoring and Information Functions of HMIPIS			
5.03.01	The HMIPIS shall be designed as an on-line system which shall process, display and store information to provide the operator, either automatically or on demand, the relevant information as indicated in subsequent clauses.			
	The following functions shall be performed by HMIPIS as a minimum:			
5.03.02	Calculations			
	01	Basic Calculations		
		All the algebraic/logical calculations related to analog points (e.g., sum/difference/average/maximum/minimum/integration, selection of one analog point out of two. based on status of digital point, duration for which an analog point is above/below a threshold, digital point (e.g., AND/OR/COMPARE. etc.), transformations, like running average, periodic average, weighted average, hourly/daily max./min. (or for a specified duration) & time of max/min., flow calculations, time projection or rate of change calculations, duration in alarm (or duration in a band), number of transgression of a point in a band etc. shall be provided. All the calculated values of the plant shall be available in the database and can be assigned to all functions just like any scanned point. It should be possible to add new algorithm for basic calculations to the standard library during detailed engineering stage.		
	02.	Performance calculations:		
		Performance Calculations for various equipment along with heat rate deviation & revenue calculation, availability tariff, merit order rating calculations etc. shall be performed as a part of PADO package described at Sub-Section: PADO.		
	03	Other Calculations:		
		Variable alarm limit calculations, alarm cut-out, frequency excursion time integration, and specific calculations intended for long term storage etc. shall also be provided, details of which shall be finalized during detailed engineering.		
	04	Assignment of Output channels		
		It shall be possible to assign any analog & binary point of MMIPIS to pre-selected output channels of Control System.		
5.03.03	Alarm monitoring and reporting			
	The system shall display history of alarms in chronological order on any of the OWS. The HMIPIS shall have the capability to store a minimum of 1000 alarms each with			
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5.03.04	paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalized during detailed engineering. The alarm display/report format shall be as approved by the Employer. Facility of audio annunciation shall be provided in LVS./OWS upon the occurrence LVS/OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation per LVS/OWS shall be provided. At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels only on a per LVS/OWS basis. Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be for each process area & each priority therein. Features viz. alarm filtering, alarm cutout and display of alarms on LVS/OWS shall be provided by the Bidder.																
	Displays																
	1	Various displays on the OWS/LVS shall as a minimum include P&ID displays or mimic, bar chart displays, X-Y & X-T plot (trend) displays, operator guidance message displays, group displays, plant start-up/shutdown message displays, system status displays etc. Number of displays and the exact functionality shall be on as required basis and as finalized during detailed engineering subject to the minimum quantities as given in subsequent clauses. For X-T & X-Y plots, the facility of providing a background grid on operator request shall be variable with adequate no. of divisions in both co-ordinates.															
	2	The minimum quantity of major types of displays per unit shall be as follows:															
		<table><tr><td>a)</td><td>Control displays (group/sub-group/sequence/loop)</td><td>(On as required. Basis subject to 500 minimum)</td></tr><tr><td>b)</td><td>P&ID/ mimic display</td><td>300</td></tr><tr><td>c)</td><td>Bar chart</td><td>100</td></tr><tr><td>d)</td><td>X-T Plot</td><td>100</td></tr><tr><td>e)</td><td>X-Y Plot (with superimposed operating curves + using user selectable stored data)</td><td>50 + 50</td></tr></table>	a)	Control displays (group/sub-group/sequence/loop)	(On as required. Basis subject to 500 minimum)	b)	P&ID/ mimic display	300	c)	Bar chart	100	d)	X-T Plot	100	e)	X-Y Plot (with superimposed operating curves + using user selectable stored data)	50 + 50
a)	Control displays (group/sub-group/sequence/loop)	(On as required. Basis subject to 500 minimum)															
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d)	X-T Plot	100															
e)	X-Y Plot (with superimposed operating curves + using user selectable stored data)	50 + 50															
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	f)	Group displays	100	
	g)	Operator guidance message	100	
	h)	Start-up/ shutdown guidance message	100	
	i)	Other Misc. displays	100	
	j)	System status & other diagnostic display	On as required basis	
	k)	Alarm facia Displays on LVS / OWS	On as required basis	
	The assignment for the above will be done by the contractor as per the requirement of operation of Contractor's system as well as for maintenance. The balance displays shall be left as spare for future modification/addition.			
3	Minimum contents & functionality of various types of displays shall be as under:- (a) Mimic displays: These displays shall depict the process in graphical form and shall cover all the drives operable from DDCMIS and all process areas being monitored therein. There shall be two types of mimic display, broadly, i.e. Overview displays & sub-area/individual displays. Operation of sequences & drives shall be generally carried out through the sub-area/ individual displays as finalized during detailed engineering. Facility of adding a user specific symbol to the standard library shall be possible. It shall be possible to go to a predefined trend display on selecting a field on any analog point on the displays. (b) Control Tile Display : In this display the drives of a loop shall be displayed with related parameters such as process value, set point, deviation, for the loop, along with facility for any selections (like A/M selection, valve selector etc.) and the command output, disturbance status & the position feed back signals, for each drive. It shall be possible to call this display as a Pop-up window from the controlled drives in main mimics.			
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	(c) Trend Display (X-T Plots) : These displays shall show the trend of analog points with respect to time. These displays shall be continuous curve plot & not point plots. Time spans of displays shall have operator selectable intervals of 5,10,15,30, 60 minutes, 8, 24 & 72 hours. In addition, zoom in/out, stretching facilities etc. shall be provided. Sufficient buffer space shall be provided to store data for minimum 500 points at scan rate for 72 hours. (d) X-Y Plots: There shall be fifteen number of such X-Y plot displays each of one page, pre-programmed in the system. At any instant of time, this page shall include up to 3 independent X-Y point plots (values of X and Y variables) of up to three equipments typically in the form of a cross 'X'. Operating curves shall be superimposed over the X-Y plot. Alphanumeric information shall be overlaid to indicate X and Y scales, point identification, current operating point value with engineering units, etc. Two or three pairs of X and Y variables having common operating curves shall be displayed on one display page only. In such cases distinct symbols shall be used to show operating point for each. The balance shall be programmable at site. (e) X-Y plot using stored data : This type of display will show the analog trend of X-axis variable with Y-axis variables. Ten numbers of such displays, each of one page shall be pre-programmed in the system. .The balance shall be as per operator's definition. (f) Sequence Displays : Sequence chain displays for each group & sub-group shall be used to trace the sequence of a control chain as well as to facilitate the operator interventions & enable mode changes/auto selection. Sequence chain display shall present complete sequence chain, in functional blocks, steps being carried out, criteria, running time, waiting time, monitoring time, operating mode, various parameters with associated engineering units for each step and criteria. It shall be possible to display a list of missing criteria for each sequence chain on operator's demand. The sequence chain display shall automatically move forward when the auto sequence is in operation.			
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	(g) Drive Level Displays : For each drive (both binary & modulating) a drive level display shall be provided which shall indicate the drive related inputs/outputs, the drive level logic and other drive related information including individual drive faults & disturbance criteria. It should be possible to call these displays as pop-up displays. (h) CLCS Displays : The loop schematic for each loop shall be available in a display form which shall show the individual analog & binary values (input/output & intermediate) and the loop tuning parameters also. (i) Group Displays : The group display shall present point information including point ID, description, current value, range, function group, quality tag & engineering unit of a group of points. (No. of points in a page shall be minimum 20). (j) Bar Graph Displays : Horizontal & Vertical bar charts shall be provided for the display of related points. The format & the point assignment shall be approved by Employer during detailed engineering. No. of bars in a display shall be limited only due to visibility & resolution & no restriction shall be there in the numbers otherwise. (k) Alarm/Fault Analysis Displays : In order to guide the operator in case of a process fault/alarm, a fault analysis display shall be provided so that the cause of the alarm, is presented to the operator. For each alarm, various reasons for the cause of the alarm shall be displayed. (l) Point Detail Display : From any display, i.e. mimic alarm or any other group display, facility shall be provided to select any point for point detail display. This display shall include all the database attributes of the point as detailed below. In the point detail display of calculated point, by simple clicking of point or through soft key it shall be possible to display the calculation used and to get further details of any other calculated points used in the calculation.			
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5.03.05	(m) Displays On large Video Screen In addition, on the top area of the LVS (around 300 mm)(In Station C&I Package scope), shall be reserved for Conventional annunciation facia which shall be displayed (normally for permanent viewing). The exact format shall be finalized during detailed engineering. Further, it shall be possible to display any annunciation signal from it's own data base (including soft signals received from Station C&I Package HMIPIS through two way data link). It is envisaged that annunciation on LVS of SG and LVS of Station C&I Package shall be presented in uniform way. To achieve this Contractor shall interact with Station C&I Package vendor and exact implementation as desired by Employer during detailed engineering shall be implemented by the Contractor.			
	(n) : Operator Guidance Message One hundred (100) number operator guidance messages as a minimum shall be developed by the Contractor.			
Logs/Summaries/Reports The system shall generate three basic types of reports/logs i.e., Event activated, Time activated and Operator demand log & summaries. The log format and point assignment for each logs/ report and other design features shall be as finalized during detailed engineering. The system shall have the facility for viewing of the logs/summaries on the OWS/LVS as well as for their copying in formats compatible to be used with MS-office or similar tools. The system will be designed for automatic printing of all the reports/logs with a provision of inhibition of the print function for each log separately, with selectable duration and selectable page/group of each log. Manual printing of time-actuated log shall also be possible. Automatic switching of any log function from a pre selected primary printer to a pre selected secondary printer (defined) on a per log basis) shall be possible. However, change in the assignment of the printers shall be possible from HMIPIS Monitors/ keyboards and programmer station.				
a. Event activated Event activated logs shall as a minimum include alarm log, trip analysis log, start-up log & control related logs & operator action log. All operator actions, modification in data base etc. shall be logged (along with historical storage) along with the username responsible for that action.				
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5.03.06	The trip analysis log shall record 30 - 100 pre-trip and 30 - 100 post-trip readings, operator selectable at site for the pre-defined parameters (not less than 250 points), sub-divided in to 25 groups. The data collection rate shall be scan rate to 2 minutes (operator selectable at site). The exact details shall as finalized during detailed engineering. The system shall be capable of generating and printing SG start-up logs, the functionality of which will be similar to the trip analysis log. b. Time Activated Logs. Time activated logs shall as a minimum includes shift log and daily log. Each of these shall provide hourly record of a minimum 250 points sub divided into 25 groups. c. Operator demand logs Operator demand logs shall include, as a minimum, digital trend log, maintenance data log, summary log, performance logs and some special logs as decided during detailed engineering stage. The system shall be capable of generating and printing trend log for a minimum of 80 groups of 15 points each. Maintenance Data Log (MDL) shall provide schedule of preventive maintenance and routine equipments inspection for 100 nos. equipment per unit and for Auxiliary Plant. The data in MDL shall include current status, total running time, running time since last maintenance, running time in current financial year, loss due to downtime etc. Exact format shall be as approved by Employer during detailed engineering. Performance log shall provide results of performance calculations. d. Various summaries Various summaries shall include off scan summary, constants summary, point quality summary, substituted values summary, peripheral status summary, alarm annunciation group summary, etc. This summaries shall also be available process area or sub-area wise, as well as based on any other data base criterion like functional group no, cabinet no, type of signal etc. Log Generation Utility The Contractor shall offer a log generation utility to generate a log/report having following facilities as a minimum.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	a. Define format of the log like header information, time, date etc. b. Selection of any point (scanned and calculated) from the data base and assign it to a log group. c. Selection of log data collection process initiating event, collection intervals (1, 2, 3, 5, 10, 30, & 60 minutes) for each point of a particular log group. Facility shall also be provided for selection of 100 points at a collection intervals of 1, 2, 3, 5, 10, 20, 30 seconds. d. Assignment of log printout initiation on event or time including, selection of the printing interval for particular log group and time of printing. (For time initiated logs). e. Assignment of no. of samples to be collected for each point. f. Select points for which minimum, maximum accumulation over a selected period, average, etc., values can be printed. Also facility shall be provided to tag the time at which the parameter passed through maximum/minimum. It shall be possible to define 100 log groups of 15 points each. Any log group can have any point from the database. One log shall include at the maximum 10 such groups.			
5.03.07	Historical storage and retrieval system (HSRS)			
5.03.08	The HSRS shall collect, store and process system data from HMIPIS data base. The data shall be saved online on hard disk and automatically transferred to portable storage device like MOD/DVD once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data (subject to minimum size indicated elsewhere in the specification).			
5.03.09	The data to be stored in the above system shall include alarm and event list, periodic plant data including data required for Residual life assessment, selected logs/reports such as event activated logs, trip analysis log, start-up log etc. The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering.			
5.03.10	The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS/LVS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk.			
5.03.11	In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable storage device like DVD. These data will include any data from the database as well as processed/computed data based on various calculations/transformation. The retrieved data from portable			
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5.03.12	storage device should be possible to be presented in form of X-T display, X-Y display, logs, reports, etc. Quality Tag - The system shall identify and tag the quality of all data (scanned and calculated points) in a way that makes all users (control, calculations, logs, displays, etc.) aware of its quality. Quality of data other than 'good' shall be clearly identified in all printouts and displays by appending quality character to the value/status of point. The quality tagging shall include good, bad, substitute, doubtful, suspect, etc. - Typically 'Good' will designate variable that satisfies all tests for quality, 'Substitute' designating a value that has been manually substituted, 'missing' and 'bad' designating a open circuit, transducer limit violation on both upper & lower side, etc. for analog inputs & open fuses, excessive number of chattering etc.		
5.03.13	Database - The database shall be organized in such a way that searching/querying & sorting on any field shall be possible. There will be minimum 10 process areas and each database point shall have various attributes as given below. - Based on these attributes & its combinations, the sorting/searching of the data shall be done. - The attributes shall include as a minimum single point ID, additional tag no., description, current value, quality tag, engineering unit (if applicable), alarm limits, dead band, alarm cutout point identifier, variable limit point identifier, conversion constants, electrical signal value & unit, alarm status, scan status, historical/long term storage frequency, plant area/sub area hardware details, reference of logic/loop diagram no. & page etc.		
5.04.00	HMIPIS Hardware		
5.04.01	The HMIPIS as specified shall be based on latest state of the art Workstations and Servers and technology suitable for industrial application & power plant environment. Two possible alternatives for HMIPIS can be offered by the Contractor as indicated in Drawing No. 4610-101-POI-A-011 and 4610-101-POI-A-012.		
5.04.02	The actual size of the Main and Bulk Memory shall be sufficient to meet the functional and parametric requirements as specified with 25% additional working memory and 50% additional bulk memory over and above the memory capacity required for system implementation. The exact system configuration and sizing shall be as approved by Employer. The Contractor to note that wherever memory (RAM or hard disk) capacity has been specified, it indicates actual "usable" Memory.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
5.04.03	The Workstation/Servers employed for HMIPIS implementation shall be based on industry standard hardware and software which will ensure easy connectivity with other systems and portability of Employer developed and third party software.				
5.04.04	Redundant sets of communication controllers shall be provided to handle all the communication between the HMIPIS and redundant system bus and to ensure specified system response time and parametric requirements. Each communication controller shall have message checking facility.				
5.04.05	Power Fail Auto Restart (PFAR) facility with automatic time update shall be provided.				
5.04.06	All the peripherals shall conform to the following minimum requirement but the exact make & model shall be as approved by Employer during detailed engineering. The LAN to be provided shall support TCP/IP protocol (Ethernet connectivity) with OPC RDI for interface with other package Control Systems and shall have data communication speed of min. 100 MBPS. All network components of LAN and Servers/ Workstations shall be compatible to the LAN, without degrading its performance. The redundant LANs of all the units shall be connected through suitable network components. It shall be ensured that failure of this network component(s), shall in no way affect individual unit's operation monitoring & control in any way.				
5.04.07	Servers/Workstations				
	Sr No.	Features	Servers (HMI Alt. I)/ Workstations for Information functions (HMI Alt. II) / Information Work Station/ PADO	Operator workstations/ Other workstations	
	1.	Processor	64 bit/32 bit with minimum specfp95 25 specint95-19	64 bit/32 bit with minimum specfp95 – 20 specint 95-15	
	2.	Memory	1 GB RAM upgradeable to 4 GB	512 RAM upgradeable to 1 GB	
	3.	Hard Disk	3 x 40 GB Ultra wide SCSI, Hot swappable	40 GB ultra wide SCSI	
	4.	Monitor (color)	Min 20” TFT Flat Monitor with resolution of 1280 x 1024 non-interfaced refresh rate min. 75 Hz.	Min 20” TFT Flat Monitor with resolution of 1280x 1024 non-interfaced refresh rate min. 75 Hz.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	5.	RAID	SCSI-channels, hardware RAID level 5 implemented.	
	6.	Redundant hot swappable power-supply	1 set	-
	7.	Removable bulk storage drive (MOD / DVD / DAT)	6 GB (minimum)	
		Removable Bulk Storage Media for above (with each server/work-station)	10 nos.	
	8.	FDD	3.5" 1.44 MB	3.5" 1.44 MB
	9.	CD ROM	40 x or higher	40 x or higher
	10.	Intelligent UPS (on line) with remote monitoring for each work-station/ server	1 no. with 30 minutes Battery backup on machine load	
	11.	Keyboard	ASCII	ASCII
	12.	Pointing Device	Mouse/Touch Screen	Mouse/Touch Screen
	13	Accessories	Industrial grade furniture as approved during detailed engineering	Industrial grade furniture as approved during detailed engineering
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
5.04.08	14.	Additional general purpose software (for using over network by servers/workstations/PCs)	Comprehensive disk maintenance utility for disk clean sweep/ crash guard/antivirus, etc. (like "Norton System Works 2000")	
	Large Video Screen (LVS) Three no Large Video Screen for SG C&I System complete with projectors, screens & associated accessories shall be supplied from Station C&I Package for use in Contractor's HMIPIS as per the following specifications. However, the control units (workstation) and associated accessories shall be provided by the Bidder as per SI. No. 5 below. - Size (diagonal) 80 inch – 84 inch - Type LCD Projection type with rear - screen configuration (other type proven technology eg. that based on digital light processing shall also be acceptable subject to Employer approval). - Resolution of each screen 1280 x 1024 pixels - Configuration of LVS Single tier with screens seamlessly combined with provision of expansion of one screen on each side. - Control Unit / Graphical generator Same as operator work station without the TFT LCD monitor. To be provided by the SG-C&I Vendor. Contractor shall provide all necessary interfaces with Station C&I Package HMIPIS so that it shall be possible to provide the top portion of this LVS to be driven by Station C&I Package HMIPIS. Further the mimic displays of Bidder's HMIPIS on the LVS shall be of identical size to that of Station C&I Package Control System as finalized during Detailed Engineering. - Video signal interface Interfacing with Video signals, to receive & project pictures from any Live camera, CCTV etc. Signal types : PAL, NTSC or SECAM in S-VHS/VHS,			
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5.04.09	No. of channels : 16			
	Remote unit for switching between video signal & HMI signal, selecting the video signal channel (live camera no./location typically) shall be provided.			
	Printers			
	Sr. No	Features	Colour Laser Printer	Colour Laser Printer
	1	Paper Size	A3	A4
	2	Printing Speed (min.)- in normal mode for A4 size paper	6 ppm (Color) 24 ppm (B&W)	4 ppm (color) 16 ppm (B&W)
	3	Type	Heavy duty, at least 50000 pages/month	Heavy duty, at least 30000 pages/month
	4	Resolution (black) (min.)	600 dpi	600 dpi
	5	First page out time (with full graphic display)	=<1 min for color, <45 sec for BW	=<1 min for color, <45 sec for BW
	6	Paper input capacity (min.)	3000 sheets	500 sheets
	7	Additional features	Automatic Duplex Printing	
8	Paper sheets (1 ream = 500 sheets) with each printer	20 reams (A3) 20 reams (A4)	20 reams (A4)	
9	Additional Cartridge/toner/ ribbon of each type as used in printer with each printer	1	1	
10	Communication ports			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.04.10	Specification of PC		
	The minimum requirement for PC shall be as below:		
	CPU	Latest generation CPU	
	Main memory	512 MB expandable to 1 GB	
	Drives	3 1/2" floppy drive, DVD/CD read/write drive	
	Hard disk	40 GB	
	Monitor	19" Full Flat TFT Resolution 1600 x 1280, refresh rate min 75 Hz	
	Graphic Memory	16 MB	
	Communication port	2 serial plus, one parallel, 1 USB port, Dual 100 Mbps Ethernet	
	Expansion slots	3	
	Other Features	101 Keys Keyboard and Optical Mouse	
	UPS	1 no. on-line Intelligent UPS with 30 minutes Battery backup on machine load (for PC & its printer) and remote monitoring are to be provided for each PC and PC based OWS.	
	Accessories	Industrial grade furniture (computer table & chair) for PC & its printer, as approved during detailed engineering.	
	Software	A	General MS Windows latest, MS-Office, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc.
	B	Application software - to suit project specific requirement	
6.00.00	PROGRAMMER'S STATION (PROGRAM DEVELOPMENT/ MODIFICATION, SYSTEM MAINTENANCE AND DOCUMENTATION FACILITY)		
6.01.00	Contractor shall provide programming facilities/systems as a minimum for Control system and HMIPIS and system documentation facility to achieve paperless documentation for DDCMIS.		
6.01.01	The programming tools shall have in-built safety features that will protect the system against inadvertent and unauthorized use of these tools. Necessary hard key locks		
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	and software locks, etc. shall be provided for this. During on line programming, external plant/equipment should not be affected.			
6.01.02	The system shall also have facility to permit the programmer to add text information at the beginning and end of each program, wherein programmer will list out his name, time, date the change which has been made, name of the person who has authorized the change, etc.			
6.02.00	Control system structuring/configuration/tuning facilities			
6.02.01	Structuring/configuring and tuning facilities shall be provided for structuring/modification, storing/loading, testing, tuning, monitoring, etc. of all the microprocessor-based controllers of the control system.			
6.02.02	It shall be possible to configure the system with ease without any special knowledge of programming or high level languages. Control strategy shall be implemented using familiar and conventional automation function blocks (software implemented). Whenever any change in configuration is done, it shall be recorded and modified configurations shall be available for printing and documentation and shall be stored in non-volatile memory. All the system configuration, tuning/fixed parameters shall be documented and printed in form of function diagrams and lists respectively.			
6.02.03	On-line tuning of the control loops shall be possible without causing any disturbance in the execution of the control loops. Provision to store and retrieve on immediate and long term basis the system configuration, data base etc. on some device such as floppy disk shall be included. Facility shall be provided to reload/down-load the system or controller module from the already stored data, on-line.			
6.03.00	HMIPIs program development/modification and system maintenance facilities			
6.03.01	Online system shall be provided for programme development/modification to achieve various functions including development, modification and testing of software of MMIPIS, generation and modification of graphics, logs, HSRS functions in an interactive manner, MMIPIS Database modification/creations, down loading the software with associated data base from the console and other features necessary for system maintenance. All operator functions shall also be available on MMIPIS programmer station. Also facility shall be provided to print system fault as detected by the online self-diagnostic routine.			
6.04.00	System Documentation Facility			
6.04.01	The system shall have the facility to generate the associated documentation for both the Control System & HMIPIs. The bidder shall furnish detailed information about system documentation facilities in his offered system along with the bid. The document, to be generated by the system shall include P&ID drawings, control loop drawings, sequence drawings, signal distribution list/drawings, system interconnection drawings, cabinets general arrangement drawings, measurement list, drive schedule, alarm schedule, system hardware and functional configuration drawings for displays, logs, trends, graphics etc. The system shall also include all			
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6.05.00	required software and hardware tools for creating, modifying and printing CAD drawings to achieve paperless documentation for DDCMIS. To realize all of the functions mentioned above the Bidder shall provide one standalone station for configuration & tuning functions of Control System as well as for HMIPIS programming, hardware of which shall be separate from the hardware of the respective system and connected to System Bus. The programmer station shall also have a colour laser printer. The system documentation facility, specified above, may be a part of the programmer station if all the functions specified above can be achieved in these programmer stations. Otherwise a separate workstation shall be provided for documentation facility with necessary software. The hardware of workstation shall be same as that of OWS.			
6.06.00	The main programming station shall be located in the programmer's room adjacent to the control room. An additional OWS cum programming station per unit shall be provided in the Control Equipment Room.			
7.00.00	DATA COMMUNICATION SYSTEM (DCS)			
7.01.00	The Data Communication System shall include a redundant System Bus for major subsystems with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus including Remote I/O bus, Soft Links (including field bus based temperature transmitters) etc shall be redundant except for backplane buses which can be non-redundant.			
7.02.00	The DCS shall have the following minimum features: Redundant communication controllers shall be provided to handle the communication between each functional group of controllers of Control System and the System Bus. The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module.			
7.02.01	If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility.			
7.02.02	Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed / logged. The above changeover shall not result in any data loss.			
7.02.03	The design and installation of the system bus shall take care of the environmental conditions and hazardous area classification as applicable to similar services.			
7.02.04	Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 50% spare capacity shall be available for future expansion.			
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7.02.05	Passive coaxial cables or fiber optic cables shall be employed for System Bus. Bidder may propose other type of cables as per their standard also which shall be subject to Employer's approval. However the following buses shall be fiber-optic only. (a) System bus connections between CER & CCR (b) System bus from locally mounted control system cabinets/OWS to central location (c) I/O Bus from remote I/OS to centrally located system cabinets.																							
7.02.06	The redundant buses shall be physically separate and shall be routed separately.																							
7.02.07	The Bidder shall furnish details regarding the communication system like communication protocol, bus utilization calculations etc.																							
7.02.08	If UTP/STP cables are used, Bidder shall supply flexible conduit for their routing.																							
7.02.09	In case of any distance or other limitation in the Data Communication System, Bidder shall provide special type of cables like optical fibers with repeaters as required to make the system fully operational.																							
8.00.00	ANNUNCIATION FUNCTIONS																							
8.01.01	The annunciation system shall be implemented as an in-built function of the DDCMIS. The field contacts shall be acquired through DDCMIS only. The annunciation sequence logic shall be implemented as a part of the DDCMIS. The annunciation logic shall include logic for presenting single alarms on a single window; logic for slow & fast flashing; logic for audible alarms (ring backs); etc. The annunciation input processing logic as per the sequence table below shall be performed for identified field/other systems binary signals or Control System generated binary signals. There shall be any limitation regarding the number of signals to be processed distributed over various functional groups.																							
8.01.02	The annunciation sequence shall conform to the following sequence: <table><tr><td>Designation</td><td>Visual</td><td>Audible (1)</td><td>Audible (2) (Ring Back)</td></tr><tr><td>Normal</td><td>Off</td><td>Off</td><td>Off</td></tr><tr><td>Alarm</td><td>Fast flashing</td><td>On</td><td>Off</td></tr><tr><td>Return to normal before acknowledge</td><td>Slow flashing</td><td>On</td><td>On</td></tr><tr><td>Acknowledged</td><td>Steady on</td><td>Off</td><td>Off</td></tr></table>				Designation	Visual	Audible (1)	Audible (2) (Ring Back)	Normal	Off	Off	Off	Alarm	Fast flashing	On	Off	Return to normal before acknowledge	Slow flashing	On	On	Acknowledged	Steady on	Off	Off
Designation	Visual	Audible (1)	Audible (2) (Ring Back)																					
Normal	Off	Off	Off																					
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BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-02 DDCMIS																				
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
	Return to Normal	Slow flashing	Off	On		
	Reset	Off	Off	Off		
	Test	Full functional/ sequence test				
8.01.03	Redundant audible devices with adjustable pitch and sound level shall be provided. Contractor shall provide redundant audible devices with selector switches. The important alarms audible, other alarms audible & ring back audible shall be differentiated from each other. The audible alarms shall be generated in the OWS as well as through external devices.					
8.01.04	Alarms shall be segregated based on their importance / priority.					
9.00.00	POWER SUPPLY, GROUNDING, CABINET/PANELS, ETC.					
9.01.00	Power Supply					
9.01.01	Contractor shall provide totally reliable & quality power supply for DDCMIS. The power supply system shall meet requirements specified under Sub-Section: Electric Power Supply of Part-B, Section-VI.					
9.01.02	Wherever hot backup or redundant equipment likes controllers, processors, I/O modules, etc. have been specified and provided, the same shall be powered through separate power supply feeders.					
9.02.00	Grounding					
	All panels, desks, cabinets shall be provided with a continuous bare copper ground bus, bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. Contractor shall meet requirements specified under sub-section: Basic Design Criteria of Part-B, Section-VI.					
9.03.00	System Cabinets/Panels					
9.03.01	All DDCMIS system modules, power supply components, other control devices (except field mounted sensors/transmitters) which are required for completeness of the system shall be housed in cabinets furnished by the Contractor. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Contractor's system and also with other systems shall also be provided by the Contractor.					
9.03.02	The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Employer approved drawings in the manufacturing works of a qualified manufacturer prior to shipment to the project site. The Contractor shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections					
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
9.03.03	through multi pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk. The DDCMIS cabinets shall be grouped into physically separate cabinets as follows: 1. Control System Cabinets 2. Marshalling cabinets 3. Relay cabinets 4. HMIPIS cabinets However, in case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided. The Contractor shall clearly identify in his enclosed Bill of Material, the quantity of all the above mentioned DDCMIS cabinets along with dimensional details as included in his offer. Further, the Contractor shall also furnish lay out of DDCMIS cabinets along with his offer to demonstrate to the Employer how the Contractor proposes to accommodate his DDCMIS cabinets in the available space as indicated in specification drawings. Contractor may make a special note that termination of field cables directly to control system cabinet is not acceptable.			
9.03.04	The Control system cabinets shall house all types of modules / hardware to achieve all functions of Control System including signal conditioning modules, controller modules, I/O modules, communication controller modules and all other requisite hardware for a complete system. All system cabinets shall be totally enclosed (with front and back doors and side panels).			
9.03.05	HMIPIS hardware like server, OWS/LVS other Work Station shall be stand-alone type with their own enclosure. The hardware along with its UPS etc. shall be mounted on a rack to be placed behind LVS. Other hardware like network component, power supply distribution etc. shall be suitably housed in cabinets, as approved by Employer.			
9.03.06	Relay cabinets (or marshalling / termination cabinet cum relay cabinets, as the case may be) shall house all the interfacing relays in the system.			
9.03.07	All the incoming / outgoing signals shall be grouped as per their origin / destination and will be terminated in the marshalling cabinets (or marshalling cum termination cabinet as the case may be). The grouping of these signals shall be subject to Employer's approval. The Contractor may make a special note that termination of field cables directly to the system cabinet (whether on TBs or on the pins on I/O modules) is not at all acceptable.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	System cabinet(s) and corresponding marshalling and termination cabinet(s) shall be a single shipping section, so that the internal wiring from field terminal to the module is done completely at the factory itself. The system cabinets shall be furnished with side panels even within a shipping section. The prefab / other cables from terminal blocks of marshalling / termination cabinets shall be taken to the system cabinets through holes provided on the side panels, and shall be properly sealed after the wiring is completed. Few additional knock-outs shall also be provided to take care of exigencies at site			
9.03.08	The type of termination and terminal blocks to be used shall be as per requirements specified under Sub-Section-Inst. cable.			
9.03.09	The design of all the cabinets and layout of all equipment, terminal blocks etc. shall be based on human Eng. Considerations, fully keeping in view the convenience of operation and maintenance personnel and shall be subject to Employer's approval during detailed engineering.			
9.03.10	Contractor shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate. In case, glanding is not possible Contractor shall indicate in his proposal his suggested procedure for cable entry and securing the cable at place. If gland plate is not provided, then a suitable plate of 2mm size shall be provided to close bottom entry of panels with proper fixing through screw at number of points for giving rigid support. Contractor shall furnish the number of cables that can be connected in each cabinet and Contractor shall provide the number of marshalling cabinets required to connect all the specified input and output points as per the arrangements decided by the Employer during detail Engg. Contractor shall also provide after the final installation of the cable, a suitable sealing material on the gland plates to ensure absolute sealing of the cabinet bottom, thereby ensuring that no dust ingress takes place from the cable entry zones. The grouping, layout of all the above cabinets shall be as approved by the Employer during detail engineering.			
9.03.11	The Contractor shall furnish with the proposal, detailed drawings and photographs giving sufficient information to demonstrate to the Employer, the internal layouts of cabinets offered, constructional features of cabinets, system of packaging of control modules in racks, wiring and cabling techniques, termination method for field cables, test facilities provided, etc.			
9.03.12	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-Basic Design Criteria (Part-B, Section-VI) and specification			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If fans/blowers are required for satisfactory system operation, dual blowers/fan with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.			
9.03.13	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.			
9.03.14	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.			
9.03.15	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish color shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable. The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment. The touch up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished. The finish colors for exterior and interior surfaces shall conform to following shades: Front & Rear-RAL 9002; End panel side- RAL 5012. Internal color shall be same as external color. Paint films which show sags, checks or other imperfections shall not be acceptable.			
9.03.16	Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.			
9.03.17	All alarm contacts located within cabinets as well as inputs/outputs from other related system shall be suitably terminated in the cabinets.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.03.18	The Contractor may submit details of his standard wiring practice for similar application for consideration and approval of Employer.			
9.04.00	Relays			
9.04.01	All the relays provided by Contractor shall be suitable for control supply of 24V DC. Each relay shall have 4 changeover type contacts & the rating of contacts shall be 5 Amp at 240V AC & 0.2A at 220V DC. The VA burden of relays shall be suitable to match the capacity of output modules (however, it shall not be more than 2.5 VA). Each relay shall be provided with a freewheeling diode. The relays shall be mounted in Field termination cum relay cabinets. All the contacts of relays shall be wired up to the cabinet terminal blocks.			
10.00.00	SYSTEM SOFTWARE REQUIREMENTS			
10.01.00	The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.			
10.02.00	Industry standard operating system like UNIX/WINDOWS NT/OPEN-VMS etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP etc.) shall be provided for MMIPIS. The system shall have user oriented programming language & graphic user interface.			
10.03.00	All system related software including Real Time Operating System, File management software, screen editor, database management software, On line diagnostics/debug software, peripheral drivers software shall be provided. Latest versions of standard PC-based software for database handling, word-processing, spread sheet, etc. and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum. Systems having program development environments like Programmer's stations, Station LAN Server shall have high level programming support like Microsoft visual studio, Oracle RDBMS etc.			
10.04.00	All application software for control system functioning like input scanning, acquisition, conditioning, processing & control along with communication among various Control System functional blocks, MMIPIS and system bus, MMIPIS software for operator interface of monitors, displays, trends, curves, bar charts etc., performance calculations (with Steam properties routines utilities), Historical storage and retrieval utility, sequence of events recording, system functions shall be provided.			
10.05.00	The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software in order to prevent unauthorized access and only Employer's authorized engineers be able to do modifications at site.			
10.06.00	Two sets of backup software on non-writeable media shall be provided.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
10.07.00	Software License The Contractor shall provide software license for all software being used in DDCMIS. The software licenses shall be provided for the project (e.g. organization or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in DDCMIS at site. All licenses shall be valid for the continuous service life of the plant. In case the s/w license is dependent on no of points, then quantity to be considered is 30% above the finally implemented points.		
10.08.00	Software Upgrades As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.		
11.00.00	SYSTEM DOCUMENTATION The Contractor shall furnish detailed system and equipment documentation. It shall include detailed system and components description covering the installation, operation, care and maintenance of all system components. All final system documentation for DDCMIS hardware and related software shall be furnished. The same shall be complete, accurate and fully representative of the supplied system and its elements. All documentation/catalogues etc., shall be furnished in English language. In addition to the hard copies, CD ROM based documentation system shall also be provided. The same should be compatible to the On-line document generation facility indicated above.		
11.01.00	Hardware documentation Detailed technical literature, reference manuals, user's guide/manuals for the complete hardware like control system hardware, MMIPIS hardware, I/O hardware, bulk memory units, peripherals and their controllers, communication hardware including controllers, man-machine interfaces programmers unit, power supply modules etc., shall be furnished by the Bidder.		
11.02.00	Operation and Maintenance manuals The operation and maintenance manuals shall include all information required for trouble shooting, repair and maintenance information regarding all equipments furnished for the completeness of the system. Sufficient documentation including block diagrams, component level circuit diagram with all component value, make, model, type, detailed wiring and external connection drawing etc., shall be provided to carryout trouble shooting and repair of all electronic cards (PCB), power supply modules at component level		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.03.00	Software Documentation And Software Listings			
11.03.01	All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the DDCMIS shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalization for Employer's review and approval.			
11.03.02	The software listings shall be submitted by the Bidder for source code of application software and all special-to-project data files			
12.00.00	TRAINING			
12.01.00	Contractor will be responsible for providing training to Employer's personnel on offered systems at Contractor's Works/Contractor's Associate's Works. It shall include training operators in the use of system, in the programming and hardware maintenance of the equipment to the extent that the Employer's personnel can make corrections and changes to the systems programs and maintains the system's hardware. For exact details and duration of training, refer to Part-C, Sub-Section-VI of specification.			
12.01.01	The maintenance and operator training shall include lectures and hands on experience on a similar type of equipment/system at manufacturers' works and site and/or Training Simulator. The details of hardware and software training shall be as finalized during detailed engineering and shall be subject to Employer's approval.			
13.00.00	WARRANTY			
13.01.00	The Bidder shall provide an unlimited warranty on all equipment and software during the Defect liability period. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to Employer.			
13.02.00	No repairs/replacement shall normally be carried out by the Employer when the plant is under the supervision of Bidder's supervisory engineers. If in the event of any emergency, in the judgment of the Employer, delay would cause serious loss or damage, repairs may be made by the Employer or a third party chosen by the Employer without advance notice to the Bidder and the cost of such work shall be paid by the Bidder.			
13.03.00	The Bidder shall provide warranty spares and an exhaustive list of warranty spares including components for system hardware and instrumentation and peripherals based on (and keeping adequate margin over) normally experienced failure rate shall be submitted by the Bidder for Employer's review regarding adequacy of the same. The Bidder must furnish the list before inviting Employer's personnel for ATS test. The warranty spares as per the list mentioned above will be dispatched by the Bidder along with the main equipment consignment. The Bidder shall also provide expandable items for the warranty period. This shall include printer ribbon, ink/toner cartridge print head etc. excluding floppy disk, M.O. Disk, tape cartridge and paper. unused spare/consumable shall be Contractor's property and taken back.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
13.04.00	In case of any hardware failure which hampers normal operation, the Contractor during the warranty period must provide on-site technical expertise to repair/rectify the problem within a week and if any component is not available at site, the Contractor must arrange to supply these components at site within additional 48 hours. If a software problem is identified, this problem shall be corrected within two weeks.			
13.05.00	After six months of DDCMIS operation, the Contractor shall provide the list of parts and expendables utilized for the period. The same information will be provided at the conclusion of the warranty.			
13.06.00	In order to discharge the warranty responsibility, the bidder shall include in his proposal lump sum price for the provisions of a team of service personnel at Site who will be fully qualified to perform the required duties throughout the warranty period of one year. The Bidder shall deploy at least one engineer, two supervisors and four technicians in the team. The Employer shall approve the exact nos. & composition of team members. In case, the team is unable to rectify hardware or software problems, the Contractor shall depute and/or station additional specialist to rectify the problem to ensure 99.7% availability of system. The availability of system shall be calculated as per Sub-section-IV, Part-A, Section-VI of specifications.			
14.00.00	ANNUAL MAINTENANCE CONTRACT (AMC)			
14.01.00	The Contractor shall provide maintenance services of complete DDCMIS System under a comprehensive Annual Maintenance Contract (AMC) for period of one year after Warranty period.			
14.02.00	The AMC shall cover total maintenance of all hardware & software coming under the scope of DDCMIS and shall include free repair/replacement of all cards/modules/peripherals/cables/components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. For the AMC the Contractor shall maintain the same staff as mentioned above for warranty period (i.e. at least one engineer, two supervisors and four technicians).			
14.03.00	Further, Contractor may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.			
14.04.00	The Contractor shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Contractor's personnel.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
15.00.00	REMOTE SERVICE CENTRE Bidder shall provide the necessary hardware & software required for connecting the DDCMIS system to Contractor's remote service centre, through which the diagnostics & fault analysis of the DDCMIS system can be carried out. The method of connection shall be as per Contractor's standard practice. However, it is preferred to have the connection through a single point in the plant's DDCMIS system. The fixed charges & running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMC price.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	CONTROL AND INSTRUMENTATION SYSTEM			
1.00.00	SG RELATED CONTROL & INSTRUMENTATION SYSTEM/EQUIPMENTS			
1.01.00	FLAME MONITORING SYSTEM			
1.01.01	The purpose of the system is to detect the individual flame and to enhance the boiler/furnace safety, to avoid spurious and unwarranted trips and to increase operational reliability, availability and efficiency of the Steam Generator such that the consumption of fuel oil shall be reduced to optimal minimum.			
1.01.02	Fail Safe, easily maintainable Flame Monitoring System shall be provided which shall include flame detectors of proven design for the type of fuel, environmental condition and other conditions, of established reliability at all loads of the Steam Generator. It shall be designed to work under all adverse conditions such as wide variation in fuel/air input ratio, wide variation in fuel characteristics, variation in operating temperature, maximum temperature under interruption of cooling air supply and shall be immune to Electro-Magnetic Interference (EMI). The system shall conform to NFPA recommendation and location of detectors as per NEC requirements. The Selection and location of the flame detectors/scanners shall be decided by the Boiler manufacturer. The Contractor shall furnish the justification of selection of flame detector locations for Employers review.			
1.01.03	Flame detector shall be working on the dynamic and static properties of primary combustion zone of each type of fuel and flicker frequency of flame. It shall pick up only the flame to which it is assigned and shall not respond to the adjacent and background flame or other radiation generated in the furnace. The design shall also take into account the absorption by a coal shroud, recirculated dust or other deposition on the flame detector head. The complete system shall provide the discrimination between oil and coal flame. Intensity indicators for main flame shall be provided along with galvanically isolated 4-20 mA DC signals and hooked to DDCMIS.			
1.01.04	The system should be easily maintainable and include automatic self test facility at regular interval.			
1.01.05	In case of tangentially fired boiler, the Bidder shall arrange flame detectors in such a manner that coal flame detectors are available both above and below each coal burner and separate oil flame detectors are provided for each oil burner. In case Bidder has discriminating type flame detectors capable of detecting and discriminating both oil and coal flame, with the help of a single scanner, the same can also be utilized for monitoring both oil and coal flame. For any other type of firing i.e. non-tangential type the flame detectors shall be provided for each coal and oil burner responding only to the flame of its associated burner.			
1.01.06	Contractor shall furnish the details of the flame detector locations and justification for the same.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.01.07	The Contractor shall demonstrate the complete performance of flame detectors in cold start up test and load condition test. In cold start up test, capability of detectors to detect oil flame under varying oil pressure shall be checked. In load test, the detector shall be able to detect when only oil is present, only coal is present and both coal and oil are present. It shall be ensured that the detectors are able to detect the proven flame at very low load with oil guns withdrawn. The above tests shall be performed for every coal and oil elevation.			
1.01.08	Provision of scanner air for cooling the flame detectors by 100% redundant Scanner Air Fans, one AC and other DC operated, shall be provided. The dampers associated with scanner air fans shall be pneumatically operated with DC solenoid valves.			
1.02.00	FLAME DETECTOR TESTING KIT			
1.02.01	The Contractor shall also provide a portable flame detector testing kit with built in stabiliser, capable of simulating both oil and coal flame, and testing of flame detector head unit at field. The testing kit shall also have facility for testing all type of electronic cards as being used in the flame monitoring system			
1.03.00	COAL FEEDERS CONTROL AND INSTRUMENTATION			
1.03.01	Contractor shall provide a microprocessor based coal Feeder C&I system having the following feature. It is preferable to use the same family of hardware as that of CLCS for implementation.			
1.03.02	Contractor shall provide a minimum of two independent speed sensors, pulser units and associated amplifiers, etc. for each of the coal feeders. Output from the speed sensors will be used to provide at least four number isolated 4-20 mA DC analog signals corresponding to coal flow rate in tons per hour and any other signals that may be required for the control of the coal feeder.			
1.03.03	Each coal feeder shall receive signals from BOP C&I part of DDCMIS for feeder speed control. The signal to be provided for the same shall be in the form of galvanically isolated 4-20 mA DC. All required power amplifier units/interface devices to accept this 4-20 mA signal shall be included			
1.03.04	All associated electronics like buffer amplifiers, frequency to current converters etc. shall be provided for each RC feeder with local speed indicators. The speed sensors shall be totally enclosed, fire, dust and weather proof, suitable for the service conditions			
1.03.05	The control cabinet shall be provided with Reset push buttons and individual lights to signal the individual Internal trip conditions Mm			
1.03.06	Each feeder shall be provided with a four position switch located at the feeder for remote off, local run (when there is no coal on conveyor) and calibration purpose.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.03.07	If there is any electronic modules mounted local to the feeder body then these shall be suitable for operating in a non-air-conditioned area in a suitable enclosure to combat the effect of noise, vibration, entry of dust etc.			
1.03.08	All necessary paddle switches and other detectors to monitor coal on belt, feeder discharge plugged, coal motion monitor etc. should be provided to ensure safe operation of the feeders.			
1.04.00	ELECTROMATIC RELIEF (SAFETY) VALVES The Electromatic safety valve shall be an automatic, electrically actuated pressure relief valve. It shall be possible to set the value for one percent or less differential between opening and closing pressure. The Electromatic safety valve shall be provided complete with all accessories like pressure measuring devices, controller units, local PB station, solenoid assembly, impulse piping etc. Provision shall also be kept to operate the Electromatic relief valves from the SG C&I part of DDCMIS LVS/OWS and miniature PB stations on the UCP. The operation of the valve shall be accomplished by operator command or by means of pressure sensitive element which shall precisely and automatically relieve the pressures within very close limits.			
1.05.00	FURNACE TEMPERATURE PROBES Contractor shall provide two numbers of furnace temperature probes before platen super heater and/or before Reheater regions and shall be electrically operated, fully retractable type. The furnace temperature probes shall be furnished with complete actuating mechanism and all the logics required for the actuating mechanism. The probe shall be provided with position transmitters, limit switch & indicator for remote indication. Each temperature probe shall have a duplex thermocouple suitable for the measurement range. Contractor shall furnish complete details of the temperature probe along with all the technical catalogues including the details of the actuating mechanism, position transmitters and limit switch which shall be subject to Employer's approval. The logics for furnace temp. Probe shall be implemented in the SG C&I part of DDCMIS.			
1.06.00	ACOUSTIC PYROMETERS			
1.06.01	Acoustic Pyrometers are to be provided to determine the average flue gas temperatures and complete flue gas temperature profile Furnace Exit plane (for FEGT measurements) and at Economiser outlet.			
1.06.02	For each temperature measurement plan/section, A PC based system complete with all required software, comprising of minimum eight nos. of acoustic transreceivers, signal processor, interface unit, PC & Colour Inkjet Printer (Common for one unit) shall be provided. The minimum specification of the PC shall be as specified in Sub-Section- DDCMIS, Section – VI, Part-B. The system shall be able to eliminate the varying high noise environment both in and out of an operating boiler.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV-I-03 SG RELATED CONTROL AND INSTRUMENTATION SYSTEM	PAGE 3 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.03	The measuring range should be sufficient to cover the entire regime of boiler operation and shall not be less than 1900°C. The mean temperature and profile temperature accuracy shall be ± 2%, & ± 4% of reading respectively or better. Full colour VDU display and colour printer output shall be provided. The system shall also provide 4-20mA DC output for SG C&I and BOP C&I part of DDCMIS.			
1.06.04	The transit time of each of the associated transmitters/receivers shall be transmitted to the central processing unit (to be located at CER) for storage and analysis through suitable interface device. A temperature profile shall then be determined and displayed by analyzing the mean temperature across every transit section using deconvolution technique. The time interval to make a complete cycle of eight transceivers should be less than one minute.			
1.06.05	The transducers shall not be placed directly in the hot gas stream. The system shall be of proven design and it's performance must be proven for at least two 210 MW rating boilers or higher rating using similar type of fuel for a period of two years. The components to be located at Boiler Area shall be able to withstand the stringent environmental condition expected at such locations with operating Boiler.			
1.06.06	In case it is the standard practice of the vendor is to supply acoustic pyrometer with separate transmitter and receiver, then the same is also acceptable subject to the condition that the configuration to be selected shall provide the same number of transit paths remains the same as with the transreceiver system specified above.			
1.07.00	FURNACE AND FLAME VIEWING SYSTEM			
1.07.01	Bidder shall include in his proposal a Furnace and flame viewing system. The flame cameras shall be suitable for direct online continuous viewing in the central control room of the coal and oil flame and condition of the furnace internals including slagging of the water walls and any other deterioration in the furnace condition. The nos. of such flame cameras to be included in the proposal shall be selected by the Bidder appropriate to his boiler design subject to minimum of four (4) numbers			
1.07.02	The flame camera system will consist of the following facilities/ components as a minimum: a 19" High resolution color monitor. b Facility for zooming and adjustment of iris from the monitor. c Proper cooling arrangement (preferably air) and protection against cooling medium failure. d Weatherproof local control box for mounting of electronics. e All necessary remote/ local programming tool. f All interconnecting cable and termination device. g Any other accessory to make the system completely operational			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.07.03	The cameras and the total system shall be suitable for the furnace design as being offered by the main boiler vendor, the firing arrangement (corner, front/ wall fired), the fuel being fired considering the ash content of worst coal. The cameras should be expected to withstand the temperature expected in the furnace of the offered boiler but shall not be less than 1600 deg C			
1.07.04	The viewing angle of the camera shall be commensurate with the furnace size, the camera location and the positioning of the burners. The system shall conform to PAL and number of TV lines shall be adequate for a clear image of the furnace			
1.07.05	The offered flame camera system shall have a record of trouble free performance of minimum one (1) year in a coal-fired boiler of size 500 MW or above where the firing arrangement is similar to the offered boiler			
1.07.06	The system shall be capable of transmitting the image to the Contractors DDCMIS system where it should be possible to display the same on the monitors of Operator workstation and the Large video screen			
1.08.00	MILL AND AIRHEATER FIRE DETECTION SYSTEM			
1.08.01	Adequate number of thermocouples type fire detection system for each Mill and Air-heater shall be provided as a composite & complete units with all required signals & accessories with adequate redundancy shall be provided			
1.08.02	The controls & protection required for the Mill detection system fire detection system shall be implemented in the SG-C&I part of DDCMIS and Air-heater fire detection system shall be implemented in the BOP C&I part of DDCMIS using rate-of-rise algorithm taking care of manufacturer's recommendation.			
1.09.00	ELECTRONIC REMOTE DRUM LEVEL MONITORING SYSTEM In case of Drum type Boiler in order to measure and monitor drum level, Bidder shall provide Electronic remote Drum Level Monitoring System working on principle of difference in electrical conductivity between steam and water. The Monitoring System shall meet the requirements as indicated below. Each end of the drum shall have independent pressure vessels with adequate no. of electrodes covering the entire range for indication for each end of drum. Further, independent and separate pressure vessels shall also be provided for each end drum/vessels along with electrodes to provide validation for low low trip setting. The sensing electrodes shall be placed in equal pitch. The maximum distance (gap) between two electrode shall be 50 mm and the electrodes shall be arranged in such a way that the last and the first electrode shall not be at any alarm or rip level. In any case, the number of electrodes shall not be less than 16 for indication and eight for validation.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	Both indication and validation system shall be supplied with double isolation valves in water, steam, drain and vent lines with suitable interlock system to be implemented in SG C&I part of DDCMIS which shall ensure a fool proof safety feature and the details of the same shall be brought out clearly in the offer. The detector unit (if not located locally), logic units, 2x100% redundant power supply units/packs (to be located in Control Equipment Room) shall be housed in separate and independent cubicles for pressure vessel on each side of the drum. The detector units, logic units etc. shall be independent for each pressure vessel. Indication shall be provided at field for both indication and validation system. Remote indication is to be provided for indication system at the unit control panel and firing floor. Each cubicle shall be provided with 2x100% redundant power supply pack converters to be fed from two feeders of 24V DC or 240V AC UPS system. These two power supplies shall be internally fused and failure of one power supply shall not affect the performance of the system. Self monitoring facility to detect and alarm the loss of power supply shall be provided. The pressure vessel shall be constructed in such a way that density level error between drum and pressure vessel shall not be more than 25 mm upto the design temp. and pressure of boiler drum. All vent, drain and isolation valves shall meet 1.5 times the max. design conditions. Electrode assembly shall have blow out and leakage proof sealing arrangement. Field proven ceramic/zirconia probe with insulation suitable for design pressure and temp. are to be provided. The system design shall be such that it shall ensure that failure of one probe circuit shall not affect another probe circuit and failure of any electrode will not hamper the system function and operation. Further the entire system shall be of proven fail-safe design. The logic shall be such that the trip and alarm relay circuits shall be independent for each for Low, Low-Low, High and High-High levels of drum. Monitoring of set time for trip generation and provision of setting time delay shall be available in the system. Trip logic shall be independent and separate from fault finding logic. The system shall have fault diagnostic features such as process fault, system hardware fault, probe failure, circuit board failure, shorted wire etc. Further the system shall be able to distinguish between a cable fault and an electrode fault. The necessary relays and relay modules for the Output Contacts shall be of proven design and each contact shall be rated for 5A, 240V AC/0.25A 220V DC rating. All these contacts shall be SPDT type.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
2.00.00 2.01.00	The system shall be proven and approved by Factory mutual, USA of equivalent, IBR etc. TRAINING Contractor shall provide training on Flame Monitoring System. Furnace and Flame Viewing System. and other systems covered under this subsection for Employer's personnel. For exact duration of training, refer to Part-C, Sub-Section-VI of specification.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	MEASURING INSTRUMENTS (PRIMARY & SECONDARY) 1.00.00 MEASURING INSTRUMENTS 1.01.00 Measuring instruments/equipment and sub systems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes/numbers as approved by the Employer during detailed engineering. 1.02.00 Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus. 1.03.00 All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price. For bidding purpose, tentative minimum instruments have been indicated on the P&IDs. However, contractor shall supply any additional local gauges/switches/transmitters/sensors for reasons mentioned above without any additional cost to the Employer. 1.04.00 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors; switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm. 1.05.00 For all instruments envisaged for sea water applications, they shall be provided with wetted parts made of monel/Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by Contractor). 1.06.00 All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-04 MEAS. INST.	PAGE 1 OF 19	

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
2.00.00	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P, FLOW AND LEVEL			
	ELECTRONIC TRANSMITTERS			
	Sl.No.	Features	Essential/Minimum Requirements	
	1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.	
	2.	Accuracy	$\pm 0.1\%$ of calibrated span (minimum)	
	3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)	
	4.	Turn down ratio	10:1 for vacuum/very low pressure applications.	
			30:1 for other applications.	
	5.	Stability	$\pm 0.1\%$ of calibrated span for six months for Ranges up to and including 70 Kg/cm ² .	
			$\pm 0.25\%$ of calibrated span for six months for Ranges more than 70 Kg/cm ² (g).	
	6.	Zero and span drift	+/- 0.015% per deg.C at max span.	
			+/-0.11% per deg.C at min. Span.	
	7.	Load impedance	500 ohm (min.)	
	8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.	
	9.	Over Pressure	150% of maximum operating pressure	
	10.	Connection (Electrical)	Plug and socket type	
	11.	Process connection	1/2 inch NPT (F)	
	12.	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.	
	13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.01.00		-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters.	
		-For hazardous area, explosions proof enclosure as described in NEC article 500.	
	14.	Diagnostics	Self Indicating feature
	15.	Power supply	24V DC ± 10%.
	16.	Adjustment/calibration/maintenance	Centralised PC based system (In Employer's Scope). In addition total two (2) no. of hand- held type universal calibrators per unit, compatible with HART protocol, shall be provided.
	Notes		
	In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.		
	LVDT type is not acceptable.		
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.		
	Ultrasonic Type level Transmitter		
Sl. No	Features	Essential/Minimum requirements	
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter.	
2.	Output signal	Galvanic ally isolated 4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol).	
3.	Sensor Accuracy	+/- 0.5% of calibrated span.	
4.	Sensor Repeatability	3 mm or better.	
5.	Power supply	24 V DC +/- 10%	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.	Temperature compensation	To be provided within transducer.	
7.	Configuration	Sensor unit and Electronic units are to be separate. It shall be possible to mount the Electronic unit at a remote accessible location from the transducer. All cables and weather proof fittings to interconnect transducer to electronic unit shall be provided by Bidder.	
8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.	
9.	Calibration	Through HART Communicator.	
10.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc	
11.	Sensor Material	Corrosion resistant material to suit individual application requirement.	
12.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry	
13.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc	
14.	Display	Minimum 4 character display with integral keypad, access protected by user code.	
15.	Diagnostics	Loss of echo alarm etc	
16.	Load Impedance	500 ohms minimum	
17.	Electrical Connection	Plug and socket	
18.	Accessories	All weather canopy for protection from direct sunlight and direct rain.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS																													
	• All mounting hardware and accessories required for erection and commissioning mounting fittings material shall be SS 316. • For hazardous areas, explosion proof enclosure as described in NEC article 500.																													
3.00.00	TEMPERATURE ELEMENTS																													
3.01.00	Thermocouple																													
	<table><thead><tr><th>Sl. No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr></thead><tbody><tr><td>1</td><td>Type of Thermocouple.</td><td>: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded type).</td></tr><tr><td>2</td><td>No. of element</td><td>: Duplex</td></tr><tr><td>3</td><td>Housing/Head</td><td>: IP-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.</td></tr><tr><td>4</td><td>Sheathing of Thermocouple</td><td>: Swaged type magnesium oxide insulation.</td></tr><tr><td>5</td><td>Calibration and accuracy</td><td>: As per IEC-751/ANSI-C-96.1(special class)for T/C.</td></tr><tr><td>6</td><td>Characteristic</td><td>: Linear with respect to temp, within ±1/2 percent of top range value.</td></tr><tr><td>7</td><td>Accessories</td><td>: Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.</td></tr><tr><td>8</td><td>Standard</td><td>: ANSI C 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well.</td></tr></tbody></table>	Sl. No.	Features	Essential/Minimum Requirements	1	Type of Thermocouple.	: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded type).	2	No. of element	: Duplex	3	Housing/Head	: IP-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.	4	Sheathing of Thermocouple	: Swaged type magnesium oxide insulation.	5	Calibration and accuracy	: As per IEC-751/ANSI-C-96.1(special class)for T/C.	6	Characteristic	: Linear with respect to temp, within ±1/2 percent of top range value.	7	Accessories	: Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.	8	Standard	: ANSI C 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
3.03.00	2 No. of element : Duplex 3 Housing/Head : IP-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection. 4 Sheathing of RTD : Metal sheathed, ceramic packed 5 Calibration and accuracy : As per DIN-43760 Class-A for RTD 6 Characteristic : Linear with respect to temp, within $\pm 1/2$ percent of top range value. 7 Accessories : Thermo well (as specified below) and shall be spring loaded for positive contacts with the well. 8 Standard : DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well. Metal Temperature Thermocouples Measuring Medium Metal Temperature Material of Thermocouple. Chromel Alumel Type K Type of Thermocouple Duplex with separate hot junctions, ungrounded Insulation Mineral Insulation Magnesium Oxide. Thermocouple wire gauge 16 AWG Protective sheath SS 321 Protective sheath dia 8 mm O.D Characteristics of Thermocouple Special limits of error as in ANSI thermocouple MC 96.01.1975 Mounting accessories 1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.			
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3.04.00 4.00.00	Cold end sealing SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin. Minimum bending radius 30 mm Length of T/C 30 Mtr. (minimum) Thermo well (for all process temp. elements) (a) Shall be one piece solid bored type of 315 SS of step-less tapered design. (As per ASME PTC 19.3 1974) (b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided. (c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if require based on the specify boiler design parameters). (d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.			
	TEMPERATURE TRANSMITTER Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself. a. Single Input Head mounted Temperature Transmitter These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65. b. Single Input DIN-rail mounted Temperature Transmitter These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.			
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	c. Dual-input Temperature Transmitter With Indicator: These shall be suitable for mounting on pipes/ support. These shall be provided for temperature measurement which are used for tripping /protection of auxiliaries e.g. for bearing temperature on which trip is envisaged. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum. d. Common requirements for each of the above type of temperature transmitters Output : 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. Input : Same transmitter shall be capable to handle Pt-100 RTD , Thermocouples –K&R types (input type to be selectable at site through HART terminal) Isolation : min. 500 V AC EMC compatibility : as per EN 61326 Operating ambient temperature : 0 to 85 deg C (without indicator) 0 to 70 deg C (with indicator) Power supply Compatible with input module of Control System Accessories Mounting arrangements including clamps etc. Composite Accuracy (a) For head mounted and DIN-rail mounted types: (Refer note 2) RTD =<0.4% of 0-250 deg C span T/C-K type =<0.4% of 0-600 deg C span T/C-R type =<0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C (b) For dual-input type: RTD =<0.25% of 0-250 deg C span T/C-K type =<0.2% of 0-600 deg C span			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-04 MEAS. INST.	PAGE 8 OF 19

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	CJC accuracy (for thermocouples) shall be =< 1 deg C Notes:- 1. In case of failure (open or burn-out) of RTD/thermocouple, temp. transmitter shall provide low temperature output. 2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. e. Field bus compatible temperature Transmitters (For Boiler Metal Temperature measurement applications) Minimum requirements shall be as follows:- Temperature signals shall be acquired using modular system consisting of I/O modules, power supply modules, field terminals and Bus Interface modules. The signals from the field shall be terminated in Terminal blocks using Cage clamp type connection. Input modules (as described below) shall acquire these process signals which shall be converted to field bus compatible signals using Bus interface modules to transfer data to DDCMIS system. Bus interface modules shall be able to support field bus protocols like PROFIBUS, Foundation Field bus etc. All the above modules shall be mounted in a Junction box. Degree of protection for this JB shall be IP 67. However, process signals shall be terminated separately using terminal blocks before entering the modular system. <table><tr><th>SI No</th><th>Features</th><th>Minimum requirement</th></tr><tr><td>1.</td><td>Input</td><td>K-type T/c, Pt 100 RTD</td></tr><tr><td>2</td><td>CJC Compensation</td><td>Integral</td></tr><tr><td>3</td><td>Accuracy</td><td>Minimum 0.4% at 23 deg C or better</td></tr><tr><td>4.</td><td>Operating temperature</td><td>0-55 deg c</td></tr><tr><td>5</td><td>Diagnostics</td><td>Wire break monitoring, Power supply healthiness etc</td></tr></table>	SI No	Features	Minimum requirement	1.	Input	K-type T/c, Pt 100 RTD	2	CJC Compensation	Integral	3	Accuracy	Minimum 0.4% at 23 deg C or better	4.	Operating temperature	0-55 deg c	5	Diagnostics	Wire break monitoring, Power supply healthiness etc	
SI No	Features	Minimum requirement																		
1.	Input	K-type T/c, Pt 100 RTD																		
2	CJC Compensation	Integral																		
3	Accuracy	Minimum 0.4% at 23 deg C or better																		
4.	Operating temperature	0-55 deg c																		
5	Diagnostics	Wire break monitoring, Power supply healthiness etc																		
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-04 MEAS. INST. PAGE 9 OF 19																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	6	Mounting	DIN rail mounted	
	7	Accessories	All required accessories shall be provided.	
	8	Power supply	24 VDC	
	9	EMC	EN 50081/EN50082 or equivalent	
5.00.00	SPECIFICATION FOR FLOW ELEMENTS			
5.01.00	Orifice Plate			
	Features		Essential/Minimum Requirements	
	Type		Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042	
	Material		316 SS	
	Thickness		3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe diameter above 300 mm.	
	Material of branch pipe		Same as main pipe	
	Root valve type		Globe	
	Root valve material		316 SS	
	Root valve size		1 inch	
	Impulse pipe of same material up to root valve		Required	
	Tapping		Flanged weld neck. 3 pairs. of tapping.	
	Beta Ratio		0.34 to 0.7	
	Beta Ratio calculation to be submitted		Yes	
	Assembly drg. and flow Vs DP Curves		Yes	
	Accessories		Root valves, flanges, Vent/drain hole (As required)	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-04 MEAS. INST.
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.02.00	Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.			
	Flow Nozzle			
	Features	Essential/Minimum Requirements		
	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042		
	Material	316 SS		
	Thickness	Suitable for intended application.		
	Material of branch pipe	Same as main pipe		
	Root valve type	Globe		
	Root valve material	316 SS		
	Root valve size	1 inch		
	Impulse pipe of same material up to root valve	Required		
	Tapping	D and D/2 (3 Nos. of tappings)		
	Beta Ratio	Around 0.7		
	Beta Ratio calculation to be submitted	Yes		
	Assembly drg. and flow Vs DP Curves	Yes		
Accessories	Root valves, vent and drain hole.			
Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.				
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-04 MEAS. INST.	PAGE 11 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
6.00.00	SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.				
	Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
			Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
	1	Sensing Element and material	Bourdon for high pressure, Diaphragm/Bellow for low pr. Of 316 SS	Mercury in steel for below 450 °C and inert gas actuated for above 450 °C of SS bulb and capillary.	Tempered toughened Borosilicate gauge glass steel armoured reflex or transparent type. *
	2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
	3	Dial size	150mm	150 mm	Tubular covering entire range
	4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
	5	Accuracy	±1% of span	± 1% of span	± 2%
	6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
	7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
	8	Over range test	Test pr. for the assembly shall be 1.5 to the max. Design pr. at 38 °C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof	
10	Zero/span adjustment	Provided	Provided	--	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.00.00	11	Identification	Engraved with service legend or laminated phenolic name plate		
	12	Accessories	Blow out disc, SS Thermowell siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.	
	13	Material of Bourdon/movement	316 SS / 304 SS	316 SS / 304 SS	
	Notes:-				
	*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
	Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				
	ROTAMETERS				
	SR. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	1.	TYPE	VARIABLE AREA METAL TUBE		
2.	FLUID MEDIA	WATER/OIL			
3.	TUBE BODY	SS316			
4.	MATERIAL OF FLOAT	316 SS			
5.	INDICATOR	LINEAR SCALE			
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
8.00.00	6. ACCESSORIES FLANGE, ORIFICE IN CASE OF BYPASS ROTA METER (FOR LINE SIZE ABOVE 100 MM) 7. HOUSING PROTECTION CLASS IP-55 8. ACCURACY ± 2% OF MEASURED VALUE.			
	PROCESS ACTUATED SWITCHES			
	FEATURES ESSENTIAL / MINIMUM REQUIREMENTS			
	Pressure/ Draft Switches/ DP Switches Temperature switches Level switches			
	Sensing Element Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum) Capacitance types for oil and dirty medium, water, condensate application. Float type switches for applications as decided by Employer during detailed engineering. Capacitance/ Conductivity/ Ultrasonic type for acid and alkali application. Radio-frequency/ Ultrasonic type for ash hopper, ash slurry application.			
	Material 316 SS Bulb 316 SS/ capillary 304 SS 316 SS			
	End connection ½ inch NPT (F) ½ inch NPT (F) Manufacturer standard			
	Over range proof pressure 150% of max. design pr. - 150% of max. design pressure			
	Repeatability ± 0.5% of full range			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
9.00.00	No. of contacts	2 No.+2NC. SPDT snap action dry contact		
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
	Elect. Connection	Plug in socket.		
	Set point/ dead band adjustment	Provided over full range.		
	Enclosure	Weather and dust proof as per IP-55		
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
	Power Supply (wherever required)	24 V DC, to be arranged by Contractor except for Ash Level Switches, where the same shall be as per Contractor's Standard practice.		
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.			
	POSITIVE DISPLACEMENT TYPE FLOW TRANSMITTERS			
The Bidder shall provide positive displacement type flow transmitters for fuel oil flow measurement, suitable for the fuel oil being used for the project, i.e., keeping in view the pressure, temperature and viscosity of the fuel oil.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
10.00.00	The meter shall be a volumetric meter type consisting of two meshing oval wheels driven by the fluid. Each revolution of the oval wheels shall displace a precisely known volume of the fluid from inlet to outlet. The housing/measuring chamber and oval wheels shall be of 316 SS. The measurement accuracy of the transmitter shall be better than +0.2%. The transmitter shall provide suitable 4-20mA dc output signal for control and indication/recording. Converters if necessary shall be provided to generate the 4-20mA signal. A local indicator of fuel oil flow shall also be provided. The instrument shall be calibrated in Tons/hr. Suitable strainer shall be provided before the transmitter for the protection of oval wheel meters against foreign matter contained in the fuel oil. The exact model no. and type of material being used, etc., shall be subject to Employer's approval during detailed engineering without any price repercussion to Employer.			
	ANALYSER INSTRUMENTS:			
	Common Requirements			
	1	Output signals Analog	4-20 mA DC	
		Binary	2 NO + 2 NC for high alarm	
	2.	Zero & span Adjustment	Available	
	3.	Ambient temp.	50 °C	
	4.	Indication	Digital	
	5.	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminium/SS	
	6.	Type of Electronics	Microprocessor based	
7.	Digital Signal transmission	RS 232 Link & to suit connections protocol to DDCMIS		
8.	Calibration	Auto & Manual (from Remote)		
9.	Error Diagnostic	To be provided		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
10.01.00	10. Others If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station (In Employer's Scope). PH Analyser 1. TYPE CELL – IN SITU 2. ACCURACY < ± 1% OF SPAN 3. RANGE 0 - 14 PH, PROGRAMMABLE 4. NO. OF STEAMS SINGLE 5. STABILITY < 0.001 PH / WEEK 6. TEMP. COEFFICIENT / TEMP. ERROR 0.001 PH / DEG. C 7. TYPE OF ELECTRONICS MICROPROCESSOR BASED WITH SELF-DIAGNOSTIC FACILITY. 8. INDICATION DIGITAL 9. ENCLOSURE WEATHER DUST PROOF (IP55) DIE CAST ALUMINUM.	
	11.00.00 SOX ANALYSER : 1 Type Sampling type 2 Principle of Measurement Radiation Absorption 3 Measurement Range 0-300 ppm/ 0-1000ppm Selectable 4 Accuracy +/- 1% of F.S. 5 Linearity +/- 1% of F.S. 6 Repeatability ≤ 0.5% of Span 7 Response time(up to 90% of full scale) ≤ 5 secs 8 Temperature Drift +/- 1% / 10 deg.C	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	9 Zero Drift < 1% span/week 10 Span Drift < 1% measured value/week 11 Operating Temperature Range 0-300 deg.C 12 Filter Ceramic 3.5 Micron 13 Accessories purging system Purging system and amplifier, XMTR etc. 14 Compensation temperature. for Yes 15 Output signals Analog 4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station. Binary 2 NO + 2 NC for high alarm 16 Zero & span Adjustment To be provided with range selection facility. 17 Ambient temp. 50°C 18 Indication Digital Alphanumeric Display. Display of reading in engineering units shall be provided. 19 Enclosure Type/Material Weather & Dust proof (IP 55) Die cast Aluminium/SS. 20 Type of Electronics Microprocessor based with self diagnostic. 21 Digital transmission Signal RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for communication with plant control system. 22 Calibration Auto & Manual (from Remote) 23 Power Supply To be arranged by Contractor subject to Employer's approval.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	24 Others All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to local junction box are to be provided. All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas. Note: Other Special Instruments for Flue Gas Desupherization System i.e Mass Flow Meter & Density Meter Shall be as per standard practice of supplier of Flue Gas Desupherization System			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ELECTRIC POWER SUPPLY SYSTEM			
1.00.00	ELECTRICAL POWER SUPPLY			
1.01.00	The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification and Employer approved drawings. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works. The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilisation of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment. The steady state & in-rush KVA for each major equipment being supplied by the Contractor shall be indicated separately.			
1.02.00	The power supply system shall be designed to meet the electrical power requirements of various C&I systems including DDCMIS and shall be configured as described below:			
1.03.00	The DC Power Supply system shall consist of the following system(s): - SG C&I System: - DC Power Supply system for SG C&I Loads shall comprise of two sets. Each set shall consist of 2 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller –one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 x 100% DC distribution board, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both sets. Auxiliary Plant System like Fuel Oil Pump House, Common Part of Mill Reject System, etc.:- DC Power Supply system shall comprise of one set as defined above except that the DC Distribution Board shall be 2x100 % and BHMS system is not required. Bidder shall clearly bring out in the proposal the redundancy features along with configuration diagram, single line diagram & data sheets etc. and this shall be finalised and subject to Employer's approval during detailed engineering.			
1.04.00	For HMIPIS portion of DDCMIS for SG C&I System including peripherals like OWS's, printers and other instruments etc. and other systems such as, panel instruments etc., requiring stabilised AC power, the same shall be provided from Employer's UPS. Bidder shall, however, furnish a list of such equipments/systems in			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	requirement of UPS power, indicating no of feeders, load requirements etc. along with the offer itself. For HMIPIS portion of DDCMIS based Control System for Auxiliary Plants including peripherals like OWS's, printers and other instruments etc. and other systems such as, panel instruments etc., requiring stabilised AC power, the same shall be provided by the Contractor through UPS system of suitable capacity. 1.05.00 For other Main Equipment related instruments, the power supply shall be derived from either the 24V DC or UPS (In Station C&I Package) as per specific requirement of the equipment supplier and as approved by Employer during detailed engineering. 1.06.00 For off-site plant control systems, separate power supply shall be provided as described in respective Sub-section Aux. Plant Ctrl., Section VI, Part B of technical specifications. 1.07.00 Contractor shall also provide local power supply distribution boxes on as required basis for sub-distribution of all 230V AC and 24V DC utility feeders for various field mounted instruments/devices (e.g. Analysers etc.) supplied by the Bidder, Remote I/O Cabinets and also for the instruments/devices provided by the Employer. The power supply distribution box shall include necessary change over circuitry (as applicable), switch fuse units, MCB, terminal blocks etc suitable for the application. The sub distribution of feeders in a local power D.B. shall be finalised during detailed engineering. Contractor to note that the minimum fuse rating in local power D.B. shall be 6 Amp. 1.08.00 The Power supply system in the above-mentioned configurations employing Microprocessor based, Intelligent modular rectifier modules, Controller, battery banks, charger, static inverters, static switches, AC/DC distribution boards & Microprocessor controlled Battery Health Monitoring System (BHMS) etc. shall meet the following specification requirements as a minimum. 2.00.00 DC POWER SUPPLY SYSTEM (24 V) 2.01.00 Microprocessor based, Intelligent, Modular Power Supply 2.01.01 Microprocessor based, Intelligent, Modular Power Supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. Either of the bank of rectifier modules shall be able to re-charge the fully discharged battery within 8 hours automatically on-line. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall have minimum 3 nos. rectifier modules for all applications. Each rectifier module shall be of minimum 10% rating of the total capacity for SG C&I loads. The exact sizing of the rectifiers in one bank shall be as approved by Employer during detailed engineering. Provision shall be available to add new modules in each rectifier cabinet for future use. While selecting the components and finalizing the cooling arrangements, Bidder to note that these rectifier modules are required to operate at 30-40 % of the rated load for most of the time.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
2.01.02	The rectifier module shall be microprocessor controlled, IGBT/Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimise harmonics. The rectifier module output regulation shall be $\pm 1\%$ or better from no load to full load with an input power supply variation of $\pm 10\%$ in voltage and $\pm 5\%$ in frequency. In addition to indications/display on rectifier panel, potential free contacts for alarms like O/P voltage high & low, battery isolated, multiple rectifier modules failed, AC Input supply out of specified range, communication fault, Battery Fuse Blown, Surge Protection Failure, Controller faulty but System running, System Overload etc., shall also be provided for use in DDCMIS. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier module voltage etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for communication with Station C&I System shall also be provided.			
2.01.03	"Float/Boost" charge functions shall be provided with alarm/indications.			
2.01.04	Each rectifier bank shall be rated for 100% load requirement and keep the connected battery full charged and one spare rectifier module.			
2.01.05	The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it.			
2.01.06	The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.			
2.01.07	The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.			
2.01.08	The rectifier module shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. The Bidder shall provide all required power cables & other accessories etc. from 415 V AC power supply system to his Electrical Power supply system.			
2.01.09	The full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to $\pm 0.5\%$ of output voltage.			
2.01.10	The rectifier module design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. This feature shall be demonstrated during factory testing at various loads.			
2.01.11	Bidder shall furnish the equipment complete in all respects along with rectifier module rating & voltage drop calculations, supporting curves/data etc.			
2.01.12	The Controller shall be intelligent, microprocessor controlled for monitoring & control of rectifier modules with features viz. Auto/Manual battery discharge test, battery			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	reserve time prediction, energy management, remote control, float/boost mode control etc.			
2.01.13	All Software as required for smooth operation and monitoring of rectifier modules in conjunction with Controller & BHMS shall be provided by the Contractor.			
2.02.00	Batteries			
2.02.01	The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. For sizing calculation, an aging factor of 0.8 and a temperature correction factor of 0.935 (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop from battery room to DCDB and DCDB to load, while sizing the battery. The system shall also be suitably designed to overcome any over voltage that may arise during low-load operation of the rectifier modules. The Contractor shall clearly bring out in his offer how the same is being implemented. Contractor to note that for Intelligent UPS (as specified in subsection DDCMIS) to be provided along with various servers/ PCs /Network switches, the Batteries shall be as per the Intelligent UPS suppliers standard practice.			
2.03.00	DC Distribution Board (DCDB) Redundant DC feeders (one from each DCDB) shall supply each of the connected loads. The exact design, rating & number of feeders of the each redundant DCDB shall be as finalised during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.			
2.04.00	Battery Health Monitoring System (BHMS) BHMS shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC (excluding Off-site plants) & UPS battery banks on-line. With BHMS it shall be possible to measure & analyse the minimum and maximum voltage values of each battery-cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the Controller and provide alarms as finalized by Employer during detailed engineering. BHMS shall be offered if all the features/functions listed herein are not a part of Controller.			
3.00.00	AUXILIARY EQUIPMENTS			
3.01.00	All required auxiliary equipment/materials as finalised during detailed engineering shall be furnished with each charger/inverter/battery bank and shall include as a minimum various meters (AC/DC voltage/current, kVA, power factor, frequency meters etc., circuit breakers, selector switches, push buttons indicating lights,			
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3.02.00	ground detector system, battery accessories like (inter cell connectors, inter step connectors, teak-wood, battery racks etc.) further, isolated 4-20 mA signals for important parameters and potential free contacts for important alarms shall be provided for use in DDCMIS.		
	One complete set of all accessories and devices required for maintenance and testing of batteries shall be supplied for each set of the batteries of each unit/plant auxiliary system. Each set include at least the following:		
	a	Hydrometer	5 Nos.
	b	Set of hydrometer syringes suitable for the vent holes in different cells	5 Nos.
	c	Thermometer for measuring electrolyte temperature	5 Nos.
	d	Specific gravity correction chart	5 Nos.
	e	Wall mounting type holder made of teak wood for hydrometer & thermometer	5 Nos.
	f	Cell testing voltmeter (3-0-3 V)	5 Nos.
	g	Alkali mixing jar	5 Nos.
	h	Rubber aprons	5 Nos.
	i	Pair of rubber gloves	5 Nos.
	j	Set of spanners	5 Nos.
	k	No smoking notice for each battery room	2 Nos.
	l	Goggles (industrial)	5 Nos.
	m	Instruction card	10 Nos.
	n	Minimum and maximum temperature indicator for battery room	1 No.
	o	Cell lifting facility	1 Set
p	Discharge Resistance	1 set.	
4.00.00	BATTERY RACKS		
4.01.00	Multi tier battery racks of teak wood construction in accordance with applicable codes and standard shall be provided. AISC specification shall apply in the absence of another design specification.		
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5.00.00	DRAWINGS/DOCUMENTS REQUIREMENTS			
5.01.00	Bidder shall furnish the power supply distribution scheme, single line diagram, all calculations such as charger/inverter rating calculations, battery sizing calculation etc., for DC system as well as for UPS during detailed engineering for Employer's review and approval.			
6.00.00	LOAD END POWER SUPPLY DISTRIBUTION			
6.01.00	Bidder shall provide power supply distribution panels/cabinets/ boxes for sub-distribution of main UPS/ DC/ Utility feeder(s) on as required basis. These shall include necessary auto-change over circuitry, switch-fuse units, MCB, terminal blocks etc. suitable for the application. The design of these distribution panels/cabinets/boxes shall be as approved by Employer during detailed engineering stage. Each of the control cabinets, however, shall be provided with redundant DC/UPS feeders.			
7.00.00	CABINETS / ENCLOSURES The Construction details for Power Supply System Cabinets/ Enclosure/Racks shall conform to the requirements of the following paragraphs. (1) Equipment enclosures shall match and line up in assemblies of freestanding floor mounted cabinets designed for indoor service. (2) Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6-mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches. (3) Each assembly may be shipped in sections for ease of handling and field assembly. Terminal blocks shall be furnished as required adjacent to each shipping split to facilitate field assembly. Cable bundles cut to the required length and furnished with terminal lugs tagged for identification shall be provided for the wiring between shipping sections. (4) Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings. (5) The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg.C above ambient temperature. Contractor shall furnish calculation to establish this during detailed engineering stage. (6) The Colour shade of Panels exterior/interior shall be as per RAL 9002, end panel Colour shall be as per RAL 5012.			
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8.00.00	COOLING SYSTEM If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirements: (1) Reserve cooling equipment shall be furnished for each assembly. Reserve fan capacity shall be equal to 100 percent of cooling fan requirements for full load operation with only one bank of rectifier/inverter in service at the specified maximum ambient temperature. (2) Completely independent duplicable wiring and control systems shall be provided for the normal cooling fan system and the reserve cooling fan system. (3) Each cooling fan shall normally run continuously and shall be powered from the output of the inverter whose enclosure it serves (for cubicles housing inverters). For other cubicles, fan power supply shall be as finalised during detailed engineering. Each cooling fan supply circuit shall be separately fused. (4) Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow.			
9.00.00	SITE TESTS The Contractor shall also carry out the site tests on equipments/systems as specified below. However, these shall not be limited to this specification only and in case any other site test is required to be conducted as a standard practice of the Contractor or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer, the same shall also be carried out.			
9.01.00	Functional Test On completion of installation and commissioning of the equipment the following tests/checks shall be carried out with the max. available load, which does not exceed the rated continuous load. These tests/checks shall include but not limited to the tests as indicated below. 1. Light Load Test This test is carried out to verify that the Power Supply System is correctly connected and all functions operate properly. The load applied is limited to some percent of rated value. The following points should be checked: (a) Output voltage, frequency and the correct operation of meters; (b) Operation of all control switches and other means to put units into operation.			
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	(c) Functioning of protective and warning devices. (d) Operation of remote signaling and remote control devices. 2. Checking of Auxiliary Devices The functioning of auxiliary devices, such as lighting, cooling, pumps, fans, annunciation, etc., should be checked, if convenient, in conjunction with the preliminary light load test. 3. Synchronisation Test If possible, frequency variation limits should be tested by use of a variable frequency generator, otherwise, by simulation of control circuit conditions. If applicable the rate of change of frequency during synchronization shall be measured. 4. A. C. Input Failure Test The test is performed with a fully charged battery and is carried out by tripping input circuit breakers or may be simulated by switching off all Power Supply System rectifiers and bypass feeder as at the same time. Output voltage variations are to be checked for specified limits with an oscilloscope or equivalent. Frequency variation is defined as the steady state frequency of the Power Supply System with and without AC input. The rate of change of frequency is measured by the time it takes to reach steady-state values. 5. A. C Input Return Test AC input return test is performed by closing AC input circuit breakers, or is simulated by energizing rectifiers and bypass feeders. Proper operation of rectifier starting and voltage and frequency variations are to be observed. Note: This test is normally performed with a fully of partially charged battery. 6 Full load test Load tests are performed by connecting the actual load to the Power Supply System output. Large Power Supply System in parallel connection may be load tested by testing the individual Power Supply System units separately. Load tests are necessary for testing output voltage and frequency, rated stored energy, recharge time, ventilation, temperature rise and determination of efficiency. Load tests are performed to prove transient voltage deviations specified under step load conditions.			
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	7 Efficiency Efficiency should be determined by the measurement of the active power at input and output. 8 Actual Load Test Conditions under actual load may differ from those with a dummy load. Steady-state generation of current and voltage harmonics and transients at load switching conditions should be observed 9 Current Division in Parallel Load sharing between the Modular DC power supply rectifier banks & Power Supply System units shall be measured with actual load under conditions of parallel operation. 10 Rated Stored Energy Time (Battery Test) This test is a load test to prove the actual possible time of battery operation. If rated load is not available in the case of large Power Supply System, it is possible to apply a partial load to check the actual battery discharge characteristics and compare these with characteristics specified by the battery manufacturer. Discharge time with rated load shall then be calculated. The test shall be performed with a fully charged battery and also may be done under other battery conditions to be specified, if so agreed. Active power output of the Power Supply System and the battery voltage shall be recorded during the test. Since new batteries often do not provide full capacity during a starting up period, the discharge test may be repeated after a reasonable recharge time if the original test has failed. 11 Rated Restored Energy Time Restored energy depends on the charging capacity of the rectifiers and the battery characteristics. If a certain recharging rate is specified, it shall be provided by repeating the discharge test after the specified charging period. 12 Battery Ripple Current If battery ripple currents are specified, then the ripple current which depends on Power Supply System operation shall be checked under normal operating conditions. Rough measuring methods are sufficient. 13 On site Ventilation Test The test is performed with the actual load. Temperature conditions of all			
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	Modular DC power supply rectifiers & Power Supply System cubicles are to be observed. 14 Overload Capability Test Overload capability test is a load test. Specified values of short time overload or starting up sequences of actual load are to be applied for the time interval specified. Specified values of voltage and current are to be recorded. 15 Restart Automatic or other restart means are to be tested after a completed shut-down as specified. 16 Output Over voltage Output over voltage protection is to be checked. 18 Periodic output voltage modulation When this test is specified, it may be checked by voltage recording at different loads and operating conditions. 19 Earth Fault Test If the DC Power Supply output is isolated from earth, then an earth fault can be applied to any output terminal. DC Power Supply output transients (if any) shall be measured. If the battery is isolated from earth, then an earth fault can be applied to any output terminals. DC Power Supply output transient (if any) shall be measured. 10.00.00 TRAINING 10.01.00 Contractor shall provide training on 24V DC system for Employer's personnel. The duration of the training shall be as elaborated in, Part-C, Section-VI.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	PROCESS CONNECTION AND PIPING			
1.00.00	PROCESS CONNECTION PIPING			
1.01.00	The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-section enclosed installation drawings and source connection drawings on as required basis for the connection of instruments and control equipment to the process and make the system complete. The installation & source connection of various items shall generally as per installation drawings (drawing no. 0000-999-POI-A-022 to 034) and source correction drawings (drawing nos. 0000-999-POI-A-035), however, the Contractor shall furnish during detailed engineering all relevant drawings, material and tech. specifications of various items service wise for Employer's approval.			
1.01.01	All materials supplied under this Sub-section shall be suitable for intended service, process, operating conditions and type of instruments used and shall fully conform to the requirements of this specification. The material offered by the Bidder shall be from reputed, experienced manufacturer whose guaranteed and trouble free operation has been proven at least for two years in not less than two pulverised coal fired utility stations.			
1.02.00	IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS			
1.02.01	All impulse pipe shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. For various applications specification of impulse pipe materials and associated fittings and valves shall be as given in Table PCP. For protection against sea environment all impulse pipes fittings etc. shall be provided with durable epoxy coating with poly urethane finish.			
1.02.02	Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A,B,C & D of the table no. PCP) the material shall be ASTM A 213 TP 316H it and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard.			
1.02.03	All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. Tee, elbow etc.) shall be ASTM A 182 Gr. 316 H for high pressure/ temperature applications (as defined above) and ASTM A 182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.			
1.02.04	The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. The disc and seat ring			
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	materials of carbon steel and alloy steel valves be ASTM A-105 and ASTM A-182, Gr. F22, hard faced with stellite (minimum hardness - 350 BHN.) The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be reconditioned and stem and disc may be replaced without removing the valve body from the line.			
1.02.05	The valve manifolds shall be of 316 stainless steel with pressure rating suitable for intended application. 2 valve manifold and 3-valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and diff. pressure transmitter/ switches respectively. 5-valve manifold shall be used for remaining applications like DP, flow and level measurements.			
1.02.06	For Pr./D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in A/F application two-way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the pr./D.P gauges.			
2.00.00	AIR SUPPLY PIPING			
2.01.00	All pneumatic piping, fittings, valves, air filter cum regulator and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided.			
2.01.01	This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements of etc.			
2.02.00	For individual supply line and control signal line to control valve, 1/4-inch size light drawn tempered copper tubing conforming to ASTM B75 shall be used. The thickness of cu-tubing shall not be less than 0.065 inch and shall be PVC coated. The fittings to be used with copper tubes shall be of cast brass, screwed type.			
2.03.00	All other air supply lines of 1/2 inch to 2 inch shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B.2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.			
2.04.00	For air supply to various devices mentioned above, the bidder shall provide 2 inch size GI pipe header with isolation valve from the instrument air and service air terminal points. In the boiler area the 2 inch head shall be provided upto top most elevation of boiler floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided upto various devices. Similar system is to be followed for service air required for intermittent purging in the Local Instrument Enclosures (LIEs) etc.			
2.05.00	All instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge			
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	and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalised during detailed engineering.			
2.06.00	All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.			
2.07.00	Purge Air Connection for Air and Flue gas Applications The continuous purging with instrument air shall be done, for all air and flue gas measurements excepting instrument air and service air instruments, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all the Air and Flue gas enclosures as per enclosed drawing no. 0000-999-POI-A-034. For intermittent purging with service air, necessary arrangements inside all the air and Flue gas enclosures shall be provided. The SS three way valve provided in the SS tubing shall be used for isolating the transmitter & connecting the service air quick disconnect line. Purging arrangement is not required for Instrument air and service air measurement applications.			
3.00.00	INSTALLATION AND ROUTING			
3.01.00	Instrument Piping System			
3.01.01	For steam and liquid measurements, the impulse pipe should preferably slope downward from source connection to instrument and instrument shall be installed below the source point. If due to any reason instrument is installed above the source point, the impulse pipe should slope upwards continuously and a 'pigtail' should be provided at the instrument to assure water seal for temperature protection. For vacuum measurements instrument shall be installed above source point and impulse pipe should slope upwards.			
3.01.02	Impulse piping for air and flue gas shall slope upwards and instrument shall be installed above source point. If this requirement cannot be met special venting or drain provision shall be provided with vent & drain lines along with isolation valves and other accessories including drainpipes. This drain is to be connected to plant drain through open funnel also.			
3.01.03	All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.			
3.01.04	Special accessories such as condensing pots/ reservoirs shall be provided and installed wherever required. In any case condensing pots shall be provided for all level measurements in steam and water services, all flow measurement in steam			
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	services and flow measurements water services above 120 Deg. C.For drum/ separator level measurement required balancing chamber shall be provided.			
3.01.05	Colour coding of all impulse pipes shall be done by the bidder in line with the colour coding being followed for the parent pipes.			
3.02.00	Instrument Air & Service Air Piping/ Tubing System			
3.02.01	Instrument air & service air headers and their branches with all associated fittings & accessories shall be provided for giving supply to all consumers, as per the requirements. Air piping shall be installed always with a slope of over 1/20 to prevent accumulation of water within the pipe.			
3.02.02	Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy checkup and for connections.			
4.00.00	PIPING/TUBING SUPPORT			
4.01.00	Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports. Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot-dip galvanized.			
5.00.00	SHOP AND SITE TESTS			
5.01.00	General Requirements			
5.01.01	The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-Q (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.			
5.01.02	Hydrostatic and pneumatic tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.			
5.02.00	Hydrostatic Testing			
5.02.01	All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.			
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5.03.00	Air Testing			
5.03.01	All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 kg/ sq. cm. through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.			
6.00.00	LOCAL INSTRUMENT ENCLOSURE AND RACKS Transmitters and switches, devices, etc. (except for all fuel oil applications which shall be mounted close to be tapping points) mounted in the field shall be suitably grouped together and mounted (i) local instruments enclosure in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas. These local instrument enclosures and racks shall be furnished as per the actual requirements finalized during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalized during detailed engineering stage subject to Employer's approval. LIEs / LIRs shall be of three types depending on the number of transmitters located in it as elaborated in the typical GA of the LIE/LIR, drawing no. 0000-999-POI-A-064. These dimensions and number of instruments indicated therein are only indicative and the exact dimensions along with the number of instruments shall be as finalized during detailed engineering stage without any price repercussions. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key. Gaskets shall be used between all mating sections to achieve protection class of IP-55. The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be			
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	provided. Exact fabrication details shall be as finalized during detailed engineering stage. The junction box for racks also shall conform to IP 55 protection class. Enclosures/racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. Each transmitter enclosure housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubing and individual purge meters for each purge line etc. as required and indicated in Instrument Installation drawings enclosed herewith. A 15 mm NB service air header shall be furnished in each instrument enclosure housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq.cm. The size of the hose shall be 1/2" minimum. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates. The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the enclosure/racks and shall be subject to Employer's approval. All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr C. The Contractor shall submit to the Employer with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed, the Contractor shall submit the qualifications of the craftsmen who will perform the work.			
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7.00.00

TABLE PCP

System/Line Description	Piping Class	Impulse Pipe Material	Schedule (Size)	Materials for Fitting/Valve Body	Valve Stem Material	Rating of Piping/ Fittings	Pr. Class of Valve
Main Steam/ Upstream of HP bypass and Auxiliary Steam Pressure reducing valve	A	ASTM-A335 Gr.P-91/22 (Note-2)	XXS (1/2 inch)	(Note-3)	(Note-3)	9000 lb	3000 SPL
BFP discharge/superheater attemperator/ spray to PRDS	B	ASTM-A106 Gr.C	160 (1/2 inch)	ASTM-A105	ASTM-A-182 Gr.F6a	6000 lb	2500
Reheater attemperator	C	ASTM-A106 Gr.C	160 (1/2 inch)	ASTM-A105	-do-	6000 lb	1500
Hot Reheat/ down stream of Aux. Steam press. Reducing valve upto desuper heater/ Flash tank drain manifold.	D	ASTM-A335 Gr.P-91/22 (Note-2)	160 (1/2 inch)	ASTM-A182 Gr.F-22	(Note-3)	3000 lb	900
Cold reheat upto Tee-off for HP Bypass / Extraction steam No. 5 to HPH	E	ASTM-A335 Gr.P-22	80 (1/2 inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000 lb	800
Cold reheat down steam of Tee-off (HP Bypass)	F	ASTM-A106 Gr.C	80 (1/2 inch)	ASTM-A105	-do-	3000 lb	800

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BFP suction/ Condensate System/ Extraction to LPH/ Ext-4 to BFPT, Deaerator/ auxiliary steam	G	ASTM-A106 Gr.B	80 (1/2 inch)	ASTM-A105	-do-	3000 lb	800
Air/ Flue gas outside furnace	M	ASTM-A106 Gr.B/C (Read Note- 4)	80 (3/4 inch)	ASTM-A105 (Read Note-4)	-do-	3000 lb	800
Air/ Flue gas inside furnace	N	ASTM-A335 Gr.P22 (Read Note- 4)	80 (3/4 inch)	ASTM-A182 Gr. F-22 (Read Note-4)	-do-	3000 lb	800

NOTE:

- 1 Rating of piping/fittings/valves etc. is subjected to the final design pressure & temperature during the detailed engineering.
- 2 In case temperature is more than 540 deg C, the material shall be P-91 only.
- 3 Material shall be compatible with that of the impulse pipe material and design parameter.
- 4 The material of impulse pipes, valve body & fittings for flue gas applications should be suitable for the type of fuel for this project.

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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	INSTRUMENTATION AND POWER SUPPLY CABLE			
1.00.00	INSTRUMENTATION CABLE, POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL			
1.01.00	General Requirements			
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.			
1.01.01	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope as illustrated in the enclosed Drg. No. 4610-101-POI-A-021 and ensuring completeness of the control system.			
1.01.02	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.			
1.01.03	Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.			
1.01.04	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.			
1.01.05	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sump price without any further cost implication to the Owner.			
2.00.00	Specification of Instrumentation cable			
2.01.00	Common Requirements			
	S. No.	Property	Requirement	
	1	Voltage grade	225 V (peak value)	
	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their	
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
	S. No.	Property	Requirement			
			amendments read along with this specification.			
	3.	Continuous operation suitability	At 70 deg. C for all types of cables, while 205 Deg C for Type-C cables.			
	4.	Progressive automatic on-line sequential marking of length in meters	To be provided at every one meter on outer sheath.			
	5.	Marking to read 'FRLS'	To be provided at every 5 meters on outer sheath except for Type-C cable.			
	6.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet			
	7.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.			
	8	Ovality at any cross-section	Not more than 1.0 mm			
	9	Others	a) Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided. b) Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground-buried installation c) Repaired cables shall not be acceptable.			
	2.02.00	Specific Requirements				
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	
	A. Conductors					
	Cross section area	0.5 sq. mm				
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एन टी पी सी NTPC
	Conductor material	ANSI type KX	ANSI type SX	High conductivity Annealed bare copper	ANSI type KX	
	Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red	
	Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1	
	No & dia of strands	7x0.3 mm (nom)				
	No. of Pairs	2	2	4,8,12,16,24,48	2	
	Max. conductor resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4 (loop)	As per ANSI MC 96.1	
	Reference Standard	As per ANSI MC 96.1		VDE 0815	As per ANSI MC 96.1	
	B. Insulation					
	Material	PVC type YI 3			Teflon (i.e. extruded FEP)	
	Thickness in mm (Min/Nom/Max)	0.25/0.3/0.35			0.4/0.50	
	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.			---	
	Voltage Rating	225 V peak operating voltage				
	Reference Standard	VDE 0207 Part 4			VDE 0207 Part 6 & ASTM D 2116.	
	Core diameter above insulation	Suitable for cage clamp connector				
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
	C. Pairing & Twisting			
	Max. lay of pairs (mm)	50		
	Single layer of Numbered binder tape on each pair provided	Yes		
	Unit formation of four pairs with printing of no. of Unit provided	N.A.	Yes	N.A.
	Conductor /pair identification as per VDE0815	N.A.	To be provided (color coding attached).	N.A.
	D. Shielding			
	Type of shielding	Al-Mylar tape		
	Individual pair shielding	No	To be provided for F-type cable	No
	Minimum thickness of Individual pair shielding	No	28 micron	No
	Overall cable assembly shielding	To be provided		
	Minimum thickness of Overall cable assembly shielding	55 micron		
	Shielding coverage	100% with at least 20% overlap		
	Drain wire provided for individual shield	N.A.	Yes (for F-type) 7-strand 20 AWG (0.51 mm ²)	N.A.
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-07 INST. AND POWER SUPPLY CABLE PAGE 4 OF 17

CLAUSE NO.	TECHNICAL REQUIREMENTS				एन टी पी सी NTPC
			annealed Tin coated copper		
	Drain wire provided for overall shield	Yes. 7-strand 20 AWG (0.51 mm ²) annealed Tin coated copper			
	E. FILLERS				
	Non-hygroscopic, flame retardant	To be provided			
	F. Outer Sheath				
	Material	Extruded PVC compound YM1 with FRLS properties		Teflon (i.e. extruded FRP)	
	Minimum Thickness at any point	1.8 mm		0.4 mm	
	Nominal Thickness at any point	>1.8 mm		0.5 mm	
	Color	Blue			
	Resistant to water, fungus, termite & rodent attack	Required			
	Oxygen index as per ASTMD-2863	not less than 29%		N.A.	
	Temperature index as per ASTMD-2863	not less than 250 deg.C		N.A.	
	acid gas generation by weight as per IEC-60754-1	Maximum 20%		N.A.	
	Smoke Density Rating as per ASTMD-2843	Maximum 60% (defined as the average area under the curve when the results of smoke density		N.A.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
		test plotted on a curve indicating light absorption vs. time as per ASTM D-2843)		
	Reference standard	VDE207 Part 5		VDE207 Part 6 & ASTM D2116
	G. Electrical Parameters			
	Mutual Capacitance Between Conductors at 0.8 KHz (Max.)	200 nF/km		120 nF/km for F type 100 nF/km for G-type 200 nF/km
	Insulation Resistance (Min.)	100 M Ohm/Km		
	Cross Talk Figure (Min.) At 0.8 KHz	60 dB		60 dB N.A.
	Characteristic Impedance (Max) At 1 KHz	N.A.		320 ohm for F-type 340 ohm for G-type N.A.
	Attenuation Figure At 1 KHz (Max)	N.A.		1.2 db/km N.A.
	H. Complete Cable			
	Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.		N.A.
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification		N.A.
	I. Accessories			
	Cable accessories of flame retardant quality.	Yes. (Accessories such as harnessing components, markers, bedding, cable jointer, binding tape etc.)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
	J. Tests				
	Routine & Acceptance tests	Refer sub-section III E			
	Type tests	Refer sub-section-CNI TYPE TEST			
	K Cable Drum				
	Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to the entire drum) or steel drum.			
	Outermost layer covered with waterproof paper	Yes			
	Painting	Entire surface to be painted			
	Length	1000 m $\pm$ 5% for up to & including 12 pairs 500 m $\pm$ 5% for above 12 pairs			
	3.00.00	SPECIFICATION OF OPTICAL FIBER CABLES (OFC)			
3.01.00	Optic Fiber cable shall be 4/8/12 core, galvanised corrugated steel taped armoured, fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.				
3.02.00	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg.C				
3.03.00	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS																													
3.04.00	Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.																													
3.05.00	Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.																													
3.06.00	Spliced / Repaired cables are not acceptable.																													
3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.																													
4.00.00	SPECIFICATION OF POWER SUPPLY CABLES Refer relevant subsections of this specification.																													
5.00.00	INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A. TABLE A: CABLE TERMINATION TO BE FOLLOWED																													
<table><tr><th colspan="2">Application</th><th colspan="2">Type Of Termination</th><th>Type Of Cable</th></tr><tr><th>FROM (A)</th><th>TO (B)</th><th>END A</th><th>END B</th><th></th></tr><tr><td>Valves/dampers drives (Integral Junction box)</td><td>Marshalling cubicle/ Marshalling cum termination Cubicle/local group JB</td><td>Plug in connector</td><td>Posts mount cage clamp type.</td><td>G</td></tr><tr><td>Transmitters, Process Actuated switches mounted in LIE/LIR</td><td>Integral Junction box of LIE/LIR</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD heads</td><td>Local junction box</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F</td></tr></table>						Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B		Valves/dampers drives (Integral Junction box)	Marshalling cubicle/ Marshalling cum termination Cubicle/local group JB	Plug in connector	Posts mount cage clamp type.	G	Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F
Application		Type Of Termination		Type Of Cable																										
FROM (A)	TO (B)	END A	END B																											
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Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G																										
RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F																										
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
	Thermocouple	CJC Box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A,B,C*	
	Other Field Mounted Instrument	Local JB/Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F,G	
	RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F	
	Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A,B,C*	
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G	
	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/Group JB/ MCC/SWGR	Marshalling Cubicle/ Marshalling cum Termination Cabinet	Cage clamp (Rail mount) type.	Posts mount cage clamp type.	F,G	
	Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp Post mounted type.	Plug in connector/Other System as per manufacturer's Standard	Internal wiring	
	Marshalling/ Termination System Cabinets	UCD mounted equipments	Post mount cage clamp type.	Plug in connector/Cage clamp type (rail mounted).	F,G (with plug-in connector at one end)	
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
	DDCMIS/PLC cabinets	PC, Printers etc.	Plug connector in	Plug connector in	Mfr.'s Standard	
	Notes	1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs. 2. For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided. 3. Also refer Drg. 3530-101-POI-A-021. 4. *For high temperature applications only. 5. Instrument Cabling for instruments/equipments covered under subsection MAIN EQP INST SYS shall be as per manufacturer's standard .				
6.00.00	TERMINAL BLOCKS					
6.01.00	All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The terminal blocks for DDCMIS input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT & VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.					
6.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, test plug bolts and test plug (as specified above for SWGR connections) transparent covers, support brackets, distance sleeves, warning label, marking, etc.					
6.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.					
6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.					
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.		
6.06.00	For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalized as per application during detail engineering stage subject to Employer's approval without any cost repercussions.		
6.07.00	Internal wiring in factory pre-wired electronic equipment cabinets may be installed according to the Bidder's standard as to wire size and method of termination or internal equipment. Terminal blocks for connection of external circuits into factory prewired electronic equipment cabinets shall meet all the requirements as specified above.		
7.00.00	INTERNAL PANELS/ SYSTEM CABINETS WIRING		
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.		
7.02.00	Wiring to door mounted devices shall be done by 19 strand copper wire provided with adequate loop lengths of hinge wire so that multiple door opening shall not cause fatigue breaking of the conductor.		
7.03.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends in Employer's approved format. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.		
7.04.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.		
7.05.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.		
7.06.00	All the special tools as may be required for solder less connections shall be provided by Bidder.		
7.07.00	Wire sizes to be utilized for internal wiring.		
	(i) Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.	0.5 Sq.mm.	
	(ii) Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC									
8.00.00	INSTRUMENTATION CABLE INSTALLATION AND ROUTING												
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.												
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows: <table><tr><td>From 11 kV/6.6 kV/3.3 kV tray system</td><td>-</td><td>914 mm</td></tr><tr><td>From 415V tray system</td><td>-</td><td>610 mm</td></tr><tr><td>From control cable tray system</td><td>-</td><td>305 mm</td></tr></table>				From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm	From 415V tray system	-	610 mm	From control cable tray system	-	305 mm
From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm											
From 415V tray system	-	610 mm											
From control cable tray system	-	305 mm											
8.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Fire proof sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.												
8.04.00	All cables shall be identified by tag. Nos. provided in Employer's approved format at both the ends as well as at an interval of 5 meters.												
8.05.00	Line voltage drop due to high resistance splices, terminal contacts, insulation resistance at terminal block, very long transmission line etc. shall be reduced as far as practicable.												
8.06.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.												
9.00.00	CABLE LAYING AND ACCESSORIES												
9.01.00	CABLE LAYING 1 CABLES SHALL BE LAID STRICTLY IN LINE WITH CABLE SCHEDULE. 2 IDENTIFICATION TAGS FOR CABLES. INDELIBLE TAGS TO BE PROVIDED AT ALL TERMINATIONS, ON BOTH SIDES OF WALL OR FLOOR CROSSING, ON EACH CONDUIT/DUCT/PIPE ENTRY/EXIT, AND AT EVERY 20 M IN CABLE TRENCH/TRAY. 3 CABLE TRAY NUMBERING AND MARKING.												
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	TO BE PROVIDED AT EVERY 10M AND AT EACH END OF CABLE WAY & BRANCH CONNECTION. 4 JOINTS FOR LESS THAN 250 METERS RUN OF CABLE SHALL NOT BE PERMITTED. 5 BURIED CABLE PROTECTION WITH CONCRETE SLABS; ROUTE MARKERS AT EVERY 20 METERS ALONG THE ROUTE & AT EVERY BEND. 6 ROAD CROSSINGS CABLES TO PASS THROUGH BURIED HIGH DENSITY PE PIPES ENCASED IN PCC. AT LEAST 300 MM CLEARANCE SHALL BE PROVIDED BETWEEN - HT POWER & LT POWER CABLES, - LT POWER & LT CONTROL CABLES - LT CONTROL & INSTRUMENTATION CABLES, SPACING BETWEEN CABLES OF SAME VOLTAGE GRADE SHALL BE IN ACCORDANCE WITH THE DERATING CRITERIA ADOPTED FOR CABLE SIZING. 7 SEGREGATION (PHYSICAL ISOLATION TO PREVENT FIRE JUMPING) A ALL CABLE ASSOCIATED WITH THE UNIT SHALL BE SEGREGATED FROM CABLES OF OTHER UNITS. B INTERPLANT CABLES OF STATION AUXILIARIES AND UNIT CRITICAL DRIVES SHALL BE SEGREGATED IN SUCH A WAY THAT NOT MORE THAN HALF OF THE DRIVES ARE LOST IN CASE OF SINGLE INCIDENT OF FIRE. 8 CABLE CLAMPING ALL CABLES LAID ON TRAYS SHALL BE NEATLY DRESSED UP & SUITABLY CLAMPED/TIED TO THE TRAY. FOR CABLES IN TREFOIL FORMATION, TREFOIL CLAMPS SHALL BE PROVIDED. 9 Optical fiber cables inside conduit shall be laid on cable trays wherever available and feasible. In areas where the same are required to be buried, the same shall be buried in separate trench approx.1.6 meter depth, to be laid in 2" GI/rodent proof HDPE conduits covered with sand, brick and soil along the pipe line route;			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	While crossing roads - to be laid in GI/rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in GI/rodent proof HDPE conduits within hume pipe. 9.02.00 Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fiber Optic Line Driver, Repeater / Modem (for Optical Fiber Cables), cable glands, grommets, lugs, termination kits etc. on as required basis. 9.03.00 Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, etc., which are required for maintenance of the system as per the type of termination used. 9.04.00 Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets. 9.05.00 No splices shall be made in conductors for instrument and control circuits except where required at connections to devices equipped with factory installed pigtails. Such splices shall be made only in approved splicing boxes of fitting with removable cover. The splices shall be made with sufficient slack left in the wires to permit withdrawal of the splice from the splicing box for ease of future disconnection of the splices. All exposed conductor or connector surfaces shall be covered with a minimum of three half-lapped layers of all weather vinyl plastic electrical tape. Taping shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the other insulation or connections requiring insulation. 9.06.00 The Bidder shall be responsible for proper grounding of all equipment under C&I package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests. All the cables etc. required for grounding of all equipments supplied under this package are to be supplied by the Bidder. 9.07.00 The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor. 10.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES (i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	(ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP). (iii) Type Door gasket shall be of synthetic rubber. (iv) Mounting clamps and accessories Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Raceways shall be provided inside JB's for proper termination of cables. (v) Type of terminal blocks Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm². A M6 earthing stud shall be provided. (vi) Protection Class IP: 55 minimum for indoor & IP-65 minimum for outdoor applications. (vii) Grounding To be provided. (viii) Color To be decided during detailed engineering & subject to Employer's approval.	
11.00.00	CONDUITS	
11.01.00	Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for actual application.	
11.02.00	The Bidder shall install conduits according to the general routing as approved by Employer and shall coordinate conduit locations with other works.	
11.03.00	All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductor. Conduit runs to individually mounted equipment shall be grounded to the Employer's cable tray grounding conductor with 12 AEG bare copper conductor. All grounding bushings, clamps and connectors shall be subject to approval of the Employer.	
11.04.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.05.00	All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.			
11.06.00	Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main building framing to the control room framing.			
11.07.00	Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements.			
	i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods. ii) Single conduit supports shall be one-hole cast metal straps and clamp backs unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.			
11.08.00	Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform to NEC requirements for the area classification.			
11.09.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.			
11.10.00	Conduits shall be securely fastened to all boxes and cabinets.			
12.00.00	CABLE SUB-TRAY & SUPPORT			
12.01.00	The cable sub-trays and the supporting system, to be generally used between Local/Group JB's and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).			
12.02.00	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. The cable trays shall not have sharp edges, burrs or projections injurious to the insulation or outer sheath of the cables.			
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12.03.00	The supporting arrangement of cable tray system shall be able to withstand the weight of the cable and cable tray system. The supporting interval shall not be more than the recommended span for the above loading for the type of cable tray selected. The tray shall not overhang by more than one meter from the support at the dead end. As far as practicable the cable sub-tray system shall be supported from one side only, in order to facilitate installation and maintenance of cables.			
12.04.00	The Bidder shall furnish and install the estimated quantities and sizes of sub trays/troughs including all required fittings and adaptors on as required basis.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	CONTROL VALVES, ACTUATORS & ACCESSORIES 1.00.00 CONTROL VALVES, ACTUATORS & ACCESSORIES 1.01.00 General Requirements 1.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the “Federal Occupational Safety and Health Standards, USA” or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification. 1.01.02 All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves. 1.01.03 This specification does not cover special type of control valves such as combined pressure and temperature control valve for Aux PRDS applications etc. 1.02.00 CONTROL VALVE SIZING & CONSTRUCTION 1.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes. 1.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer’s approval during detailed engineering. 1.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.			
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1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV.			
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.			
2.00.00	VALVE CONSTRUCTION			
2.01.00	All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.			
2.02.00	Valves with high lift cage guided plugs & quick-change trims shall be supplied.			
2.03.00	Cast Iron valves are not acceptable.			
2.04.00	Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.			
2.05.00	Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.			
2.06.00	All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)			
2.07.00	Valve characteristic shall match with the process characteristics.			
2.08.00	Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.			
2.09.00	Flanged valves shall be rated at no less then ANSI press class of 300 lbs.			
3.00.00	VALVE MATERIALS			
	Sr. No.	Service	Body material	Trim Material
	1	Non-corrosive, non-flashing	Carbon steel ASTM-A216 Gr. WCB for fluid temperature below 275 Deg. C	316SS stellited with stellited faced guide posts and bushings.
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CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
		and non-cavitation service	Alloy steel ASTM-A217Gr. WC9 for fluid temperature above 275 Deg. C	
	2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. 440 C WC9	
	3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. 17-4 PH SS WC6	
	4.	Condensate, DM water service	316 SS	316 SS
	NOTE Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.			
	However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.			
4.00.00	END PREPARATION			
	Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.			
5.00.00	VALVE ACTUATORS			
	All control valves shall be furnished with pneumatic actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.			
	Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.			
	The travel time of the pneumatic actuators shall not exceed 10 seconds.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.00.00	CONTROL VALVE ACCESSORY DEVICES		
6.01.00	All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.		
7.00.00	SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER		
	Electrical	Input Signal	4-20 mA
		Power Supply	Loop Powered from the output card of Control System.
		Hart Protocol	Compatibility For Remote Calibration & Diagnostics(Super-Imposed Hart Signal On Input Signal(4-20 mA)
		Valve Position Sensing	Position Sensing (Non Contact-Type),4-20 Ma O/P Signal For Control System To Be Provided
	Environment	Operating Temp	(-)30 To 80 Deg. C
		Humidity	0-95 %
		Protection Class	IP-65 Minimum
	Software For Configuration And Diagnostic	Software	Windows Based Software. Software Shall Meet the Requirement For Configuration, Diagnostics, Calibration And Testing Of The Actuator
		Diagnostic/Test Features	Advanced Diagnostic Features Like Stroke Counter Or Travel Counter, Leakage In Actuators, On Line Partial Closure Test, Valve Signature Analysis, Step Response Test, Valve Friction /Jamming Detection Etc To Be Provided
		Factory Valve Signature Tests Reports (Pr Vs Valve Travel And Travel Vs I/P Signal) are to be provided.	
	Hardware	PC	For Configuration/Software Ref PC Specified Under DDCMIS Section
	Tests Certificates	Test certificates as per Manufacture Standard/Relevant Standard are To Be Submitted	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Configuration/	Remote Calibration, Auto & Manual Calibration Shall Be Possible	
	Operating	Operating Range	Full Range & Split Range Signal Range
	Modes	Valve Action	Direct & Reverse. Valve Action
		Flow Characterization	Possible To Fit Valve Characteristic Curve Linear & Equal Percentage
	Fail Safe/Fail Freeze	Fail Safe/Fail Freeze Feature is to Be Provided.	
	Pneumatic	Air Capacity	Sufficient To Handle The Valves Selected/Boosters To Be Supplied If Required.
		Air Supply Pressure	To Suit The Air Supply Pressure/Quality Available.
		Process Connection	1/4 Inch NPT
	Performance	Characteristic Deviation	$\leq 0.5\%$ Of Span
		Ambient Temp Effect	$\leq 0.01\%$ /Deg C Or Better
	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent
	Accessories	In Built Operator Panel	Display With Push Buttons For Configuration And Display On The Positioner Itself (Password Protected/Hardware Lock)
		Hand Held Hart Calibrator	Universal Hart Calibrator To Be Provided, One Per Unit
		Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As On Required Basis For Making System Complete.
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
8.00.00	TEST AND EXAMINATION All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following: 8.01.00 Non Destructive Test as per ANSI B-16.34. 8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test. 8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above. 8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position. 8.05.00 CV Test: CV test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be furnished for Employer's approval.			
9.00.00	CONTROL VALVE QUANTITIES Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS			
1.00.00	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES			
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at IIIC, Part-A, Section VI.			
1.02.00	The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID. Also refer item MEASURING INSTRUMENTS, Subsection CONTROL & INST, Part A, Section VI.			
1.03.00	All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-section: MEAS INST Part-B, Section VI. In addition, all electrical instrument devices like switches/transmitters/controllers/analysers/solenoid valves which are located in the field/hazardous locations like hydrogen generation plant shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All field wiring should be through conduits. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.			
1.04.00	Contractor shall provide independent control systems for safe, efficient and reliable operation of the plant auxiliary systems. The type of control system shall be as indicated under scope part at IIIC, Part-A, Section VI.			
1.05.00	ON/OFF control, indication, annunciation of incomers and bus-coupler are also to be performed from Contractor's Control System for each of the above system as applicable.			
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller modules without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules shall in no way jeopardize safety of plant and personnel.			
1.07.00	The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	(HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault, failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as colour change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.			
1.08.00	The Control system shall operate in non-air conditioned area and shall meet the minimum requirements as specified below. The Contractor shall, however, provide a Package AC for his control system his Control system. The Control system shall meet the minimum requirements as specified below.			
1.09.00	Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-999-POI-A-013.			
2.00.00	PROGRAMMABLE LOGIC BASED CONTROL SYSTEM			
2.01.00	PLC PROCESSOR The processor unit shall be capable of executing the following functions:- - a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. - b Implementing all logic functions for control, protection and annunciation of the equipment and systems. - c Implementing modulating control function for certain application as specified elsewhere in the specification. - d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. - e Performing self-monitoring and diagnostic functions.			
2.02.00	Wherever Dual processor based PLC system has been specified, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group.			
2.03.00	The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.			
2.04.00	Priority of different commands shall be as follows:			
2.04.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.			
2.04.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.			
2.05.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS) PC based OWS (Operator Work Station) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface System. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided. Refer Subsection II C, Part A, and Section VI for exact number of Operator Workstations to be provided for each of the control systems. Specification of PC is provided below. 2.05.01 All OWS of the HMIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area on drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files. Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS. 2.05.02 All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions. 2.05.03 The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required			
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	for smooth operation, control & management of information as finalized during detailed engineering.			
2.05.04	The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.			
2.05.05	The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator).			
	When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.			
2.06.00	PROGRAMMING FUNCTIONALITIES			
	Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language. For example, the programming of PLC shall use either of the following:-			
	Flow-chart or block logic representing the instructions graphically.			
	Ladder diagrams.			
	The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.			
	All programming functionalities shall be password protected to avoid unauthorized modification.			
2.07.00	SOFTWARE REQUIREMENT			
	All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.			
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	The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification. Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface. All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum. All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided. The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.			
3.00.00	INPUT/OUTPUT MODULES			
3.01.00	The PLC system should be designed according to the location of the input/output cabinets as specified.			
3.02.00	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, RTD, Thermocouple, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays, 4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing nos. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/Drives.			
3.03.00	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.			
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.			
3.05.00	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of			
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3.06.00 3.07.00 3.08.00 3.09.00 3.10.00 3.11.00 3.12.00 3.13.00 3.13.01 3.13.02	inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems. All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply. The Contractor shall provide the following monitoring features: - a Power supply monitoring. - b Contact bounce filtering. - c Optical isolation between input and output signals with the internal circuits - d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering. Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog output modules shall be able to drive an load impedance of 500 Ohms minimum. Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware. Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required, shall be done by the contractor in PLC system. All input field interrogation voltage shall be 24V DC or 48 V DC. In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper alarm/message. Wiring Scheme for inputs to control system shall be as follows: Each of the triple redundant binary & analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group. The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:			
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3.13.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.																					
3.13.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.																					
3.14.00	Binary & analog outputs shall be non-redundant only. Failure of any single module shall not affect operation of more than one single drive.																					
3.15.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.																					
3.16.00	The maximum number of inputs/outputs to be connected to each type of module shall be as follows: <table><tr><td>1</td><td>: Analog input module</td><td>16</td></tr><tr><td>2</td><td>: Analog output module</td><td>16</td></tr><tr><td>3</td><td>: Binary input module</td><td>32</td></tr><tr><td>4</td><td>: Binary output module</td><td>32</td></tr><tr><td>5</td><td>: Analog input & output (combined)</td><td>16</td></tr><tr><td>6</td><td>: Binary input and output (combined)</td><td>32</td></tr></table> Note: For binary inputs, one changeover contact is counted as 2 inputs.				1	: Analog input module	16	2	: Analog output module	16	3	: Binary input module	32	4	: Binary output module	32	5	: Analog input & output (combined)	16	6	: Binary input and output (combined)	32
1	: Analog input module	16																				
2	: Analog output module	16																				
3	: Binary input module	32																				
4	: Binary output module	32																				
5	: Analog input & output (combined)	16																				
6	: Binary input and output (combined)	32																				
3.16.01	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station CRTs for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the CRTs.																					
3.17.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 600 meters from the Central PLC, fiber optic data link has to be provided.																					
4.00.00	SYSTEM SPARE CAPACITY																					
4.01.01	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have																					
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	spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:			
4.01.02	10% spare channels in input/output modules fully wired up to cabinets TB.			
4.01.03	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.			
4.01.04	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.			
4.01.05	The Data communication system shall have the capacity to handle the additions mentioned above.			
4.01.06	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.			
4.01.07	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.			
5.00.00	DATA COMMUNICATION SYSTEM (DCS)			
5.01.00	The Data Communication System shall include a redundant Main System Bus with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant. The DCS shall have the following minimum features : - a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station. - b The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module			
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	connected to the system bus shall not result in loss of any communication function to and from any other station/module. c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility. d Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged. e The design and installation of the system bus shall take care of the environmental conditions as applicable. f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion. g Passive coaxial cables or fiber optic cables shall be employed. The Contractor shall furnish details regarding the communication system like communication protocol, bus utilization calculations etc.			
5.02.00	The PLC system shall be provided with necessary interface hardware and software for dual fiber optic connectivity & interconnection with station wide LAN (In Employer's Scope) for two - way transfer of signals for the purpose of information sharing. The plant information shall be made available through an Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engineering. All required plant data shall be transferred to/from through this ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering. The Contractor shall provide all assistance to the BOP C&I System (In Employer's Scope) Supplier including co-ordination and flow of required information etc. for display of all input points under alarm, connected to PLC or generated by PLC, on various operating stations on BOP C&I System (In Employer's Scope) and various client PCs on station LAN.			
6.00.00	SYSTEM REACTION TIME			
6.01.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.			
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7.00.00 7.01.01 7.01.02 7.01.03 7.01.04 7.01.05	OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalized during detailed Engineering Stage. Historical storage and retrieval system (HSRS) The HSRS shall collect store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data. The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports. The data/information to be stored & frequency of storage and retrieval shall be as finalized during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk. In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based on various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of X-T display, X-Y display, logs, reports, etc. The system shall have provision of generation. Of reports and logs. General only two types of logs shall be. Reports and Logs:- The system shall have provision of generation of reports and logs. Generally two types of logs shall be provided. i) Time dependent - Periodically generated (shift log, daily log etc.). ii) Event dependent - Provision of thirty logs/reports of each type shall be provided.			
8.00.00 8.01.00	CONTROL & POWER SUPPLY SCHEME For PLC system, redundant 24 V DC power supply shall be provided by the contractor. Necessary redundant transformers and redundant chargers with 24 V DC battery back-up shall be provided by the Contractor to derive power supply from 415 V, 3-phase 3-wire incomers to be arranged by the Contractor at the input terminals			
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	of Power supply cabinets. The Contractor shall, however, furnish all required hardware/ equipment/ cubicles for conversion and/or stabilization of the power source provided by the Owner to all other levels which may be necessary for meeting the individual requirements of equipments/ systems furnished by him within the Contractor's quoted lump sum price. For separately mounted I/O racks, separate power supplies shall be provided. Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. All the drives shall be switched ON/OFF through 24V DC coupling relays to be provided in HT/LT SWGR panels. Power supply distribution from Contractor's power supply cabinets shall be in the scope of Contractor. The exact power supply scheme shall be as approved by Employer during detailed Engineering stage.			
8.02.00	The battery shall be Ni-Cd type batteries with long life and shall be able to provide a back-up for one hour at full load requirement of the complete control system.			
8.03.00	For remote I/O cabinets, micro PLC etc, separate redundant power supplies, suitable for 415V, 3-phase 3-wire incomers shall be provided. The equipment of power supply unit can be mounted as an integral part of the enclosure and the same shall provide all voltages necessary to power the processor and I/O modules. All required redundant power packs etc. with inbuilt chargers, with minimum thirty minutes battery back-up shall be provided .Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. However, the exact power supply scheme shall be as approved by Employer during detailed Engineering stage.			
9.00.00	CONTROL CABINETS / PANELS / DESKS			
9.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-basic Design criteria (Part-B, Section-VI) and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.			
9.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.			
9.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear			
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	doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.			
9.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.			
9.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalized during detailed engineering. (b.) Interior:- Same as above. Paint films which show sags, checks or other imperfections shall not be acceptable. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable. The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory painted surfaces of each item of equipment. The touch-up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.			
9.01.05	Refer Subsection Basic Design Criteria, Part B, Section VI for grounding requirements.			
9.02.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.			
9.03.00	Control Desk			
9.03.01	PC based OWS (operator Work Station) of PLC shall be mounted on table type control desk to house PC/ keyboards/ mouse etc. Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 34 mm thick wooden top shall be provided on the desk with proper finish of acrylic PVC/polyurethane paint. All operators work stations shall be			
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	mounted on this Control Desk. Employer supplied PA system hand sets, telephone sets and CCTV monitors shall also be mounted. Very few A/M Stations & PB stations and lamps may also be mounted on the control desk if found necessary. The Keyboard shall be capable of being pulled out through a tray. The desk shall be arranged in an continuous arc shape. The exact profile of the desk, dimension and the radius of curvature shall be finalized during detailed engineering stage.			
9.03.02	To achieve durable & water resistant finish, a coat of "Polyuthesive crystal clear" on the surface of unit control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of Control Desk should be in line with relevant International standards.			
9.03.03	Two nos. industrial grade chairs will be provided with control desk.			
10.00.00	ANNUNCIATION SYSTEM			
10.01.00	Only OWS based alarm system shall be provided with audio alarm facility (beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided.			
10.02.00	The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalized during detailed engineering. The alarm display/report format shall be as approved by the Employer.			
10.03.00	Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation per OWS shall be provided.			
10.04.00	At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels only on a per OWS basis.			
10.05.00	Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be for each process area & each priority therein.			
10.06.00	The annunciator sequence shall conform to ISA sequence ISA-2A.			
10.07.00	Annunciation facia windows are to be provided in local control panels where ever specified. The number of annunciation facia windows and the provision for original input will be on as required basis.			
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10.08.00	SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS																	
10.08.01	All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalisation for Employer's review and approval.																	
10.08.02	All The software listings including Source code for application software, All special-to-project data files etc. shall be submitted by the Contractor:																	
10.09.00	SOFTWARE LICENCES The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant.																	
10.10.00	Software Upgrades As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.																	
11.00.00	SPECIFICATIONS OF OPERATOR WORK STATION The minimum requirement for PC based OWS shall be as below: <table><tr><td>CPU</td><td>Latest generation CPU</td></tr><tr><td>Main memory</td><td>512 MB expandable to 1 GB</td></tr><tr><td>Drives</td><td>3 1/2" floppy drive, 48 x CD ROM drive</td></tr><tr><td>Hard disk</td><td>40 GB</td></tr><tr><td>Removable bulk storage drive (MOD / DVD / DAT)</td><td>6 GB (minimum)</td></tr><tr><td>Removable Bulk Storage Media</td><td>for 10 nos. above</td></tr><tr><td>Monitor</td><td>19" Full Flat TFT Resolution 1280 x 1024, refresh rate min 85 Hz.</td></tr></table>				CPU	Latest generation CPU	Main memory	512 MB expandable to 1 GB	Drives	3 1/2" floppy drive, 48 x CD ROM drive	Hard disk	40 GB	Removable bulk storage drive (MOD / DVD / DAT)	6 GB (minimum)	Removable Bulk Storage Media	for 10 nos. above	Monitor	19" Full Flat TFT Resolution 1280 x 1024, refresh rate min 85 Hz.
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Removable Bulk Storage Media	for 10 nos. above																	
Monitor	19" Full Flat TFT Resolution 1280 x 1024, refresh rate min 85 Hz.																	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-09 AUX. PLANT CONTROL SYSTEM	PAGE 14 OF 15														

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Graphic Memory 16 MB Communication port 2 serial plus, one parallel, 1 USB port, Dual 100 Mbps Ethernet. Expansion slots 3 Other Features 101 Keys Keyboard and Optical Mouse UPS 1 no. on-line Intelligent UPS with 30 mins. Battery backup on machine load (for PC & its printer) and remote monitoring are to be provided for each PC and PC based OWS. Software - a General MS Windows latest version, MS-Office, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc. - b Application software - to suit project specific requirement	
12.00.00	PRINTER Printer shall be provided as a part of the HMIS system.	
13.00.00	TRAINING Contractor shall provide training on PLC systems for Employee personnel. The exact duration of the training shall be as per Part-C, Section-VI.	
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-09 AUX. PLANT CONTROL SYSTEM PAGE 15 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	TYPE TEST REQUIREMENTS	
1.00.00	TYPE TEST REQUIREMENTS	
1.01.00	General Requirements	
1.01.01	The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. (b) For the rest, submission of type test results and certificate shall be acceptable provided. i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment. ii. There has been no change in the components from the offered equipment & tested equipment. iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening. (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.	
1.01.02	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.	
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.	
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.01.05	parameters, interval of recording precautions to be taken etc. for the tests to be carried out. The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.			
2.00.00	SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS			
2.01.00	The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems shall be as indicated below: i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test. ii) Dry Heat test as per IEC-68-2-2 or equivalent. iii) Damp Heat test as per IEC-68-2-3 or equivalent. iv) Vibration test as per IEC-68-2-6 or equivalent. v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent. vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent. vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent. Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC					
3.00.00	TYPE TEST REQUIREMENT FOR C&I SYSTEMS					
	Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
	1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
	2	Thermocouple	Degree of protection test	IS-2147	No	No
	3	CJC Box	Degree of protection test	IS-2147	No	No
	4	RTD	As per standard (col 4)	IEC-60751	No	No
	5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
	6	E/P converter	As per standard (col 4)	Mfr. standard	No	Yes
	7	Instrumentation Cables Twisted & Shielded				
		-Conductor	Resistance test	VDE-0815	Yes	Yes
			Diameter test	IS-10810	Yes	Yes
			Tin Coating test (Persulphate test)	IS-8130	Yes	Yes
		-Insulation	Loss of mass	VDE 0472	Yes	Yes
			Ageing in air ovens**	VDE 0472	Yes	Yes
			Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
			Heat shock	VDE 0472	Yes	Yes
			Hot deformation	VDE 0472	Yes	Yes
			Shrinkage	VDE 0472	Yes	Yes
			Bleeding & blooming	IS-10810	Yes	Yes
		-Inner sheath***	Loss of mass	VDE 0472	Yes	Yes
			Heat shock	VDE 0472	Yes	Yes
			Cold bend/ cold impact test	VDE 0472	Yes	Yes
			Hot deformation	VDE 0472	Yes	Yes
			Shrinkage	VDE 0472	Yes	Yes
		-Outer sheath	Loss of mass	VDE 0472	Yes	Yes
			Ageing in air ovens**	VDE 0472	Yes	Yes
			Tensile strength and elongation test before and after ageing**	VDE 0472	Yes	Yes
			Heat shock	VDE 0472	Yes	Yes
			Hot deformation	VDE 0472	Yes	Yes
			Shrinkage	VDE 0472	Yes	Yes
			Bleeding & blooming	IS-10810	Yes	Yes
			Colour fastness to water	IS-5831	Yes	Yes
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
			Cold bend/ cold impact test	VDE-0472	Yes	Yes
			Oxygen index test	ASTMD- 2863	Yes	Yes
			Smoke Density Test	ASTMD- 2843	Yes	Yes
			Acid gas generation test	IEC-60754- 1	Yes	Yes
		-fillers	Oxygen index test	ASTMD- 2863	Yes	Yes
			Acid gas generation test	IEC-60754- 1	Yes	Yes
		-AL-MYLAR shield	Continuity test		Yes	Yes
			Shield thickness		Yes	Yes
			Overlap test		Yes	Yes
		-Over all cable	Flammability Test	IEEE 383	Yes	Yes
			Swedish Chimney Test	SEN 4241475	Yes	Yes
			Noise interference	IEEE Trans- actions	Yes	Yes
			Dimensional checks	IS 10810	Yes	Yes
			Cross talk	VDE-0472	Yes	Yes
			Mutual capacitance	VDE-0472	Yes	Yes
		HV test	VDE-0815	Yes	Yes	
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CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
			Drain wire continuity		Yes	Yes
	* For Drain wire only					
	**These tests shall be carried out as per VDE0207 Part 6 & ASTM D-2116 for TEFLON insulated & outer sheathed cables					
	***Applicable for armoured cables only					
	8	DC Power Supply System (Applicable for each model and rating)				
			Degree of protection test	IS-13949	Yes	Yes
			Short circuit current capability	Approved procedure	Yes	Yes
			Voltage Proof Test	UL 950, IEC950	Yes	Yes
			Burn In test	Approved procedure	Yes	Yes
			Efficiency	Approved procedure	Yes	Yes
			Audible Noise Test	Approved procedure	Yes	Yes
			Fuse Clearing Capability	Approved procedure	Yes	Yes
			Total harmonic content	Approved procedure /CIGRES	Yes	Yes
			Radio Frequency interference	IEC-CISPR22, IEC-61000-4-12(9b), IEC-61000-4-3, IEC-61000-4-5, IEC-61000-4-6	Yes	Yes
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
			Over Load Test	Approved procedure	Yes	Yes
			Restart Test	Approved procedure	Yes	Yes
			Output voltage tolerance	Approved procedure	Yes	Yes
			Parallel operation	Approved procedure	Yes	Yes
			ESD immunity Test	IEC-61000-4-2-9(1)	Yes	Yes
			Electrical Fast transient/Burst Immunity Test	IEC-61000-4-4	Yes	Yes
			Surge Protection	IEC61312, IEC61024, VDE 100-534	Yes	Yes
			Insulation Test	Approved procedure	Yes	Yes
			Load Tests.	Approved procedure	Yes	Yes
			Preliminary light load test (without Battery supply)	Approved procedure	Yes	Yes
			Load sharing	Approved procedure	Yes	Yes
	9	Battery	As per standard	IS-10918	No	Yes
	10	Voltage Stabiliser	Over Load Test	Approved procedure	No	Yes
			Temp rise test without redundant fans	Approved procedure	No	Yes
			Input voltage variation test	Approved procedure	No	Yes
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-10 TYPE TEST REQUIREMENTS	PAGE 7 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS 					
	11	DDCMIS				
		CLCS Systems	Model test	Approved procedure	Yes	Yes
		BMS	Safety requirements	VDE0116 Sec 8.7	No	Yes
	12	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
	13	Local Gauges	Degree of protection test	IS-2147	No	No
	14	Process actuated Switches	Degree of protection test	IS-2147	No	No
	15	Control Valves	CV test	ISA 75.02	Yes	Yes
	16	PLCs	As per standard	IEC 1131	No	No
	17	LIE / LIR /Junction Box	Degree of protection test	IS-2147	Yes	Yes
	18	Flue gas O2 analyser, other Flue Gas analysers	Degree of protection test	IS-2147	No	Yes
	19	Flow Nozzle Orifice plates	Calibration	ASME PTC BS 1042	Yes	Yes
Note: Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.						
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE			TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2		SUB-SECTION-IV:I-10 TYPE TEST REQUIREMENTS	PAGE 8 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	PLANT PERFORMANCE ANALYSIS, DIAGNOSIS & OPTIMISATION SOFTWARE	
1.00.00	PLANT PERFORMANCE ANALYSIS, DIAGNOSIS & OPTIMIZATION SOFTWARE	
1.01.00	The Contractor shall provide PC based On line Plant Performance Analysis, Diagnosis & Optimization System (PADO) for the station. The PADO shall incorporate the complete thermal design model of each unit. The model of each unit shall work together from the same PC for the complete plant. The system shall use the measured data from the Station C&I Package through appropriate interface to be provided by the Bidder. Instruments, which are specifically required for implementation of PADO, shall be in the scope of Contractor.	
1.02.00	The PADO system shall provide the following functions in a modular and seamlessly integrated environment, using a common plant model and a dynamically shared database:	
2.00.00	PERFORMANCE ANALYSIS AND MONITORING OF SYSTEMS AND COMPONENTS	
2.01.00	Calculate thermal performance status of the plant and efficiency of generation using measured data.	
2.02.00	Calculate all the key system performance indicators at system level such as heat rate, plant and equipment efficiency generator output and controllable losses.	
2.03.00	Analyze the impact of individual component performance on overall losses or gains in total megawatt generation.	
2.04.00	Perform detailed analysis of each component including calculation of key performance indicators such as efficiency, heat transfer coefficient, TTD, DCA, and fouling factor.	
2.05.00	What if analysis at system and component level.	
3.00.00	EMISSION ANALYSIS AND MONITORING	
3.01.00	Monitor, track and analyze plant emissions such as SO ₂ , NO _x , CO and CO ₂ in real time.	
3.02.00	Monitor and analyze ESP and stack conditions such as temperature, humidity, gas flow rate and opacity.	
3.03.00	Facilitate obtaining lowest emission while maintaining combustion efficiency.	
3.04.00	Facility to set alarms to highlight conditions that violate predefined limits.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.00.00	SYSTEM AND PERFORMANCE DIAGNOSIS			
4.01.00	Evaluate system and component performance degradation to detect worn plant equipment			
4.02.00	Expert system diagnostics using neural and Bayesian belief networks and historical data for quick identification of problem pinpointing down to within the component.			
4.03.00	Identify degradation of measuring instruments.			
5.00.00	SYSTEM AND PERFORMANCE OPTIMIZATION			
5.01.00	Recommend to operator controllable parameter settings to optimize given process or activity at the measured operating condition, using state of the art optimization techniques.			
5.02.00	Optimize control system design to determine the optimum values of parameters for individual control loops.			
6.00.00	OTHER FUNCTIONS In addition to the above functions, the PADO system shall possess the following analytical features: - a Verify the accuracy and provide the correct estimated value of the faulty or missing measurements. - b Data created by one function shall be used to perform analysis using another set of functions without any processing or conditioning of the data. - c Simultaneous use of functions by one user on a single workstation or multiple users across multiple workstations. - d Create alternative configuration of a unit, to study the impact of component replacements or changing the routing of fluid flows. - e The PADO system should be fully compatible with the functions of BPOS system			
7.00.00	BOILER PERFORMANCE OPTIMIZATION SYSTEM The Contractor shall provide a PC based on line Boiler Performance Optimization System (BPOS) for each steam generator. The BPOS shall incorporate the complete thermal design model of the boiler capable of both forward and backward calculation of complete boiler thermal performance. The model shall be calibrated and made "Site Specific" based on series of field trials of thermal performance of the boiler during startup and prior to Trial Operation. The input for the BPOS shall be based on accurate and continuous on line grid measurement of the following:			
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-11 PADO	PAGE 2 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00	a. Flue gas temperature at Economizer outlet using Acoustic pyrometer. b. Flue gas oxygen. c. Other fluid temperature(s) entering and exiting various heat transfer banks. d. Coal characteristics The BPOS shall be capable for continuous on-line calculation of the thermal performance of the boiler for the operating conditions indicating performance prediction zonal absorption, metal temperature and shall have necessarily the following features. i. Fuel switching capability. ii. "WHAT IF" capability. iii. Selective soot blowing of Furnace/Super heater based on trends of zonal absorption. iv. Expert system diagnostics for quick identification of the 'Root Cause' of deviations from the predicted parameters. The computer modeling and arriving at factors to make it "Site Specific" shall be to the approval of the Owner. The BPOS shall be furnished complete with the appropriate computer hardware to the approval of the Owner.			
	OTHER REQUIREMENTS The Plant Performance Analysis, Diagnosis & Optimization System (PADO), as described above, shall also include the following:- a. Boiler performance optimization packages including the optimized operation of soot Blowing System. b. Boiler stress condition analyzer. c. Interactive water and gas chemistry management system. d. Regenerative Cycle performance optimization system.			
9.00.00	HARDWARE REQUIREMENTS The hardware shall include a computer server and at least 5 workstations along with the complete networking in a LAN network. Refer Sub-section DDCMIS for the specification of Server and Workstations.			
9.01.00				
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CLAUSE NO.	TECHNICAL REQUIREMENTS 			
9.02.00	The implementation of all the associated hardware, networking and related work shall be the responsibility of the bidder in order to successfully operate the software. Values Calculated by PADO software shall be available as calculated data base points in Unit HMI database of Distributed Control System (DCS) (In Employer's Scope) through appropriate interface to be provided by the Bidder for Display and recording. The supplier free of cost shall support the tools under warranty for a period of 5 years from the date of Trial Operation.			
9.03.00				
9.04.00				
BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION-IV:I-11 PADO	PAGE 4 OF 4	

GENERAL TECHNICAL REQUIREMENTS

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PART - C

GENERAL TECHNICAL REQUIREMENT

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	GENERAL TECHNICAL REQUIREMENT			
1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical requirements brought out in the Technical Specifications and the Technical Data Sheets.			
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.			
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice may also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.			
4.00.00	COMPLETENESS OF FACILITIES			
4.01.00	Bidders may note that this is a Contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.			
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.00.00	CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following: (a) Bureau of Indian Standards (BIS) (b) Indian electricity act (c) Indian electricity rules (d) Indian Explosives Act (e) Indian Factories Act and State Factories Act (f) Indian Boiler Regulations (IBR) (g) Regulations of the Central Pollution Control Board, India (h) Regulations of the Ministry of Environment & Forest (MOEF), Government of India (i) Pollution Control Regulations of Department of Environment, Government of India (j) State Pollution Control Board. (k) Rules for Electrical installation by Tariff Advisory Committee (TAC). (l) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (m) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (n) Explosive Rules, 1983 (o) Petroleum Act, 1984 (p) Petroleum Rules, 1976, (q) Gas Cylinder Rules, 1981 (r) Static and Mobile Pressure Vessels (Unified) Rules, 1981			
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5.02.00	(s) Workmen's Compensation Act, 1923 (t) Workmen's Compensation Rules, 1924 (u) NTPC Safety Rules for Construction and Erection (v) NTPC Safety Policy (w) Any other statutory codes / standards / regulations, as may be applicable. Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply: (a) Japanese Industrial Standards (JIS) (b) American National Standards Institute (ANSI) (c) American Society of Testing and Materials (ASTM) (d) American Society of Mechanical Engineers (ASME) (e) American Petroleum Institute (API) (f) Standards of the Hydraulic Institute, U.S.A. (g) International Organisation for Standardization (ISO) (h) Tubular Exchanger Manufacturer's Association (TEMA) (i) American Welding Society (AWS) (j) National Electrical Manufacturers Association (NEMA) (k) National Fire Protection Association (NFPA) (l) International Electro-Technical Commission (IEC) / European Norm (EN) (m) Expansion Joint Manufacturers Association (EJMA) (n) Heat Exchange Institute (HEI)			
	5.03.00	Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else where in the specification together		
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5.04.00	with the complete word to word translation of the standard that is normally not published in English. As regards highly standardized equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.		
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.		
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, and structural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.		
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.		
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE		
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given elsewhere in the technical specification. These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.		
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.		
7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS		
7.01.00	Design of Facilities All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the		
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7.02.00	rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit. Maintenance and Availability Considerations Equipment/facilities offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the turbine and equipments, inspection of the steam path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the Contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the Contractor for lifting the equipment and accessories covered under the specification.			
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is a Contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope. Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated. The Contractor shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheet.			
8.02.00	The number of copies/prints/floppy discs/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I			
8.03.00	The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following :			
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	(a) Basic Engineering Documentation Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i. System description of all the mechanical, electrical, control & instrumentation & civil systems. ii. Technology scan for each system / sub-system & equipment. iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. iv. Optimization studies including thermal cycle optimization. v. Sizing criteria of all the systems, sub-systems including various piping systems/ equipments/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins. vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups. vii. Operation Philosophy and the control philosophy of the equipments / system covered under the scope. viii. General Layout plan of the power station incorporating all facilities in Contractor's as well as those in the Employer's scope. This drawing shall also be furnished in the form of floppy discs to the Employer for engineering of areas not included in Contractor's scope. ix. Basic layouts and cross sections of the Main Plant Building (various floor elevations), and other areas included in the scope of the Contractor. x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. xi. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer. (b) Detailed Engineering Documents i. General layout plan of the station.			
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	ii. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii. Flow diagrams, Process & Instrumentation Diagrams along with write-up and system description. iv. Start-up curves for boiler, for various start-ups, viz. cold, warm and hot start-up including combined start up curves for boiler & turbine under cold, warm & hot up start up conditions. v. Piping isometric, composite layout and fabrication drawings. vi. Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules. vii. Technical data sheets for all bought out and manufactured items. Contractor shall use the NTPC specifications as a base for placement of orders on their sub-vendors. viii. Detailed design calculations for components, system/sub-system,, piping etc., wherever applicable including sizing calculations for all auxiliaries as per criteria specified elsewhere in specification. ix. Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier. x. Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data along with stress analysis isometrics showing nodes. xi. Thermal cycle information (heat balance diagrams, boiler performance calculations, thermal calculations etc.). xii. Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for equipment like pumps, compressors, other heat exchangers & equipments covered under the package. xiii. Comprehensive list of all terminal points which interface with Employer's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc. xiv. Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xv. Protection system diagrams and relay settings.			
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	xvi. Interconnection diagrams. xvii. Cable routing plan. xviii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix. Alarm and annunciation list and alarms & trip set points. xx. Sequence and protection interlock schemes. xxi. Type test reports and power system stability study report. xxii. Control system configuration diagrams and card circuit diagrams and maintenance details. xxiii. Detailed software manuals & source software listing. xxiv. Detailed flow chart for digital control system. xxv. Man Machine Interface application engineering drawings & documents. xxvi. Civil & Structural works drawings and documents for all structures, facilities, foundations, underground and overground works and super-structural works as included in the scope of the Bidder. xxvii. Model study reports wherever applicable. xxviii. Functional & Guarantee test procedures and test reports. xxix. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. xxx. Documentation in respect of commissioning as listed out elsewhere in this specification. xxxi. Maintenance schedule for boiler & auxiliaries & ESP clearly indicating interval, duration if shutdown required, man hours required and tools & tackles required for the maintenance. 8.03.01 The Contractor while submitting the above documents / drawings for approval / reference as the case may be, shall mark on each copy of submission the reference letter along with the date vide which the submissions are made.			
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8.03.02	Instruction Manuals The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-I. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following: (a) Erection Manuals The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. i) Erection strategy. ii) Sequence of erection. iii) Erection instructions. iv) Critical checks and permissible deviation/tolerances. v) List of tool, tackles, heavy equipments like cranes, dozers, etc. vi) Bill of Materials vii) Procedure for erection. viii) General safety procedures to followed during erection/installation. ix) Procedure for initial checking after erection. x) Procedure for testing and acceptance norms. xi) Procedure / Check list for pre-commissioning activities. xii) Procedure / Check list for commissioning of the system. xiii) Safety precautions to be followed in electrical supply distribution during erection (b) Operation & Maintenance Manuals i) The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be			
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	in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The Contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Employer. ii) If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Employer for records. iii) A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings. iv) The manuals shall include the following : a) List of spare parts along with their drawing and catalogues and procedure for ordering spares. b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation. c) Where applicable, fault location charts shall be included to facilitate finding the cause of mal operation or break down. v) Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant. vi) On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Employer indicating lubrication method for each type/category of bearing.			
8.03.03	Plant Handbook The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including			
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	1. Design and performance data. 2. Process & Instrumentation diagrams. 3. Single line diagrams. 4. Sequence & Protection Interlock Schemes. 5. Alarm and trip values. 6. Performance Curves. 7. General layout plan and layout of main plant building and auxiliary buildings 8. Important Dos & Don'ts The plant handbook shall be submitted within twelve (12) months from the date of award of Contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.			
8.03.04	Project Completion Report The Contractor shall submit a Project Completion Report at the time of handing over the plant.			
8.03.05	Drawings (a) (i) All the plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check. (ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I. The soft copies to be supplied shall be either in CDs, Floppies or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form. (iii) Final copies of the approved drawings shall be submitted in vector form on CD-ROM along with the requisite number of hard copies as per Annexure-I. (iv) The completed plant documentation including integrated 3D model with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. attached to the respective equipments / systems in the 3D model shall be furnished to			
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	Employer, along with the design review software which shall include interference check and walk-through animation, loaded on suitable hardware (server and work station). The software shall include facility for obtaining hard copies of all the drawings/documents on standard plotter / printer. The requisite hardware and software shall be supplied and commissioned by the Contractor at Employer's Engineering Office Complex at Noida as per mutually agreed schedule. (b) All documents/text information shall be in latest version of MS Office and MS Excel as applicable. (c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. (d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. (e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to Contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract. (f) The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". (g) Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission. (h) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and			
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	Contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer / Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this Contract. (i) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. (j) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. (k) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority / representative of Employer based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package. (l) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability. (m) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment/ system to "as built" conditions. (n) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The			
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8.04.00	Contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The Contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. (o) The Contractor shall submit adequate prints of drawings / data / documents for Employer's review and approval. The Employer shall review the drawings and return one (1) copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the Contract schedule. (p) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the Contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.						
	Engineering Information Submission Schedule Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information along with the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts. (a) Information that shall be submitted for the approval of the Employer before proceeding further, and (b) Information that would be submitted for Employer's information only. The Engineering Information Schedule shall be updated month wise. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the Contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.						
	<table><tr><td>BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE</td><td>TECHNICAL SPECIFICATIONS SECTION-VI, PART-C BID DOCUMENT NO.: CS-4610-101-2</td><td>SUB-SECTION GTR</td><td>PAGE 14 OF 39</td></tr></table>				BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-C BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION GTR
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8.05.00	Engineering Progress and Exception Report			
8.05.01	Report giving the status of each engineering information including			
	(a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission			
	(b) Drawings which were not submitted as per agreed schedule.			
8.05.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the Contract, which shall then be discussed and finalised with the Employer.			
8.05.03	Bidder to update Master Drawing List (MDL) monthly and shall be submitted to the Employer in every first week of month.			
8.06.00	Technical Co-ordination Meeting			
8.06.01	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of Contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.			
8.06.02	The Contractor should note that Time is the essence of the Contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.			
8.06.03	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.			
8.06.04	Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.			
8.06.05	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.			
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8.07.00	Design Improvements The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
8.08.00	Training of Employer's Personnel			
8.08.01	Training for Employers O&M Personnel The scope of service under training of Employer's engineers shall include a training module covering upto thirty five (35) man months in the areas of Operation & Maintenance. Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer: (a) Training for Steam Generator & ESP Equipment & Auxiliaries. (b) Training for Electric Systems including VFD (c) Training for other SG related C&I systems/equipments. (d) Training for special packages for various PC based systems specified elsewhere in Part-B of Technical Specification, Section-VI. (e) DDCMIS as detailed in Part-B (f) Training for power cycle piping/critical piping.			
8.08.02	Training for Employers Engineering Personnel The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering a training module of upto 15 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product deign softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-II.			
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8.08.03	Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above (i.e. 35 & 15 months respectively for O&M and Engineering) is indicative only. Employer reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.			
8.08.04	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.			
8.08.05	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.			
8.08.06	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.			
8.09.00	Equipment bases A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
8.10.00	Protective Guards Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
8.11.00	Lubricants, Servo Fluids and Chemicals			
8.11.01	The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.			
8.11.02	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be			
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	furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer along with lubrication requirements.			
8.12.00	Lubrication			
8.12.01	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.			
8.13.00	Material of Construction			
8.13.01	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.			
8.14.00	Rating Plates, Name Plates & Labels			
8.14.01	Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, tag number, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.			
8.14.02	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.			
8.14.03	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear sides.			
8.14.04	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
8.14.05	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.			
8.14.06	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.			
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8.14.07	Safety and relief valves shall be provided with the following : (a) Manufacturer's identification. (b) Nominal inlet and outlet sizes in mm. (c) Set pressure in Kg/cm ² (abs). (d) Blowdown and accumulation as percentage of set pressure. (e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in liters of water per minute.			
8.14.08	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
8.14.09	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system			
8.15.00	Tools and tackles The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder along with the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.			
8.16.00	Welding			
8.16.01	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
8.17.00	Colour Code for all Equipments/ Pippings/ Pipe Services			
8.17.01	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
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8.18.00	Protection and Preservative Shop Coating			
8.18.01	Protection All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. Being a coastal power station, the parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be. The requirements for painting specification shall be complied with as detailed detailed out in Part-A & B of the Technical Specification.			
8.19.00	Preservative Shop Coating All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.			
8.19.01	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.			
8.19.02	All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Employer.			
8.19.03	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.			
8.19.04	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.			
9.00.00	QUALITY ASSURANCE PROGRAMME			
9.01.00	The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the			
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	specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001.A quality assurance programme of the contractor shall generally cover the following: (a.) His organisation structure for the management and implementation of the proposed quality assurance programme (b.) Quality System Manual (c.) Design Control System (d.) Documentation and Data Control System (e.) Qualification data for bidder's key personnel. (f.) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. (g.) System for shop manufacturing and site erection controls including process, fabrication and assembly. (h.) Control of non-conforming items and system for corrective actions and resolution of deviations. (i.) Inspection and test procedure both for manufacture and field activities. (j.) Control of calibration and testing of measuring testing equipment. (k.) System for Quality Audits. (l.) System for identification and appraisal of inspection status. (m.) System for authorising release of manufactured product to the Employer. (n.) System for handling, transportation, storage delivery and preservation (o.) System for maintenance of records, and (p.) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component. 9.02.00 General Requirements - Quality Assurance 9.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per			
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	a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-01/F3. Monthly progress reports on MQP/FQP submission/approval shall be furnished on enclosed format No. QS-01-QAI-P-02/F1 9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM. 9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site. 9.02.04 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning. 9.02.05 The contractor shall submit to the Employer Field Welding Schedule for field welding activities for High Pressure Parts like Boiler, Turbine, Power Cycle Piping, Critical Structures etc. in the enclosed format No.: QS-01-CQA-W-11/F1. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.			
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9.02.06	The contractor shall have suitable Field Quality Organisation with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organisational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.			
9.02.07	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).			
9.02.08	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.			
9.02.09	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.			
9.02.10	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.			
9.02.11	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.			
9.02.12	For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipment/ systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.			
9.02.13	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.			
9.02.14	No welding shall be carried out on cast iron components for repair.			
9.02.15	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.			
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9.02.16	All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co- relation of the test report with the job. All bar stock / forging of diameter equal to or greater than 50 mm shall be ultrasonically tested. In general all plates equal to or greater than 40mm and for pressure parts, plate of thickness equal to or greater than 25mm shall be ultrasonically tested unless otherwise as specified in respective specification.			
9.02.17	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/ equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished on enclosed on format no. QS-01-QAI-P-02/F2. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.			
9.02.18	The contractor should have QA & Inspection organization for carrying out inspection at manufacturer's works and at site, as per the approved quality plan. In case, the contractor proposes to engage third party inspection agency to carry out the inspection on his behalf, the same shall be done only after obtaining due approval from the Employer well in advance.			
9.02.19	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to			
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9.02.20 9.02.21 9.02.22 9.02.23 9.02.24 9.02.25 9.02.26 9.02.27	the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract. Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance. The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan. Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc. The contractor shall inform Employer of any change to the quality programme or staff that will affect the quality system and obtain Employer's agreement prior to implementation of this change. During execution of contract, all Deviations/Non Conformities to the specification, approved quality plan and applicable standard must be documented and referred to the Employer along with technical justification for approval and disposition. For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable. Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative. Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment (a) All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle. (i) Elevated Temperature Test Cycle During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be		
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	maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C. (b) Burn in Test Cycle The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. In case the Contractor/ sub-contractor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Contractor/ sub- contractor along with the statistical figures to validate the alternate procedure to be forwarded. The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed uring detailed engineering stage. 9.03.00 QA DOCUMENTATION PACKAGE The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick mark. 9.03.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.		
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9.03.02	The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks. Typical contents of QA Documentation is as below:- (a) Quality Plan (b) Material mill test reports on components as specified by the specification and approved Quality Plans. (c) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e) Heat Treatment Certificate/Record (Time- temperature Chart) (f) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure). (g) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h) Certificate of Conformance (COC) wherever applicable. (i) MDCC			
9.03.03	Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
9.03.04	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review. (a) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release. (b) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract			
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	documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. (c) If a decision is made despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.			
9.03.05	Transmission of QA Documentation On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.			
9.04.00	Project Manager’s Supervision			
9.04.01	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of ‘Arbitration’ clause in Section GCC of Vol.I, the Contractor shall proceed to comply with the Project Manager's decision.			
9.04.02	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: (a) Interpretation of all the terms and conditions of these documents and specifications: (b) Review and interpretation of all the Contractor’s drawing, engineering data, etc: (c) Witness or his authorised representative to witness tests and trials either at the manufacturer’s works or at site, or at any place where work is performed under the contract : (d) Inspect, accept or reject any equipment, material and work under the contract :			
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	(e) Issue certificate of acceptance and/or progressive payment and final payment certificates (f) Review and suggest modifications and improvement in completion schedules from time to time, and (g) Supervise Quality Assurance Programme implementation at all stages of the works.			
9.05.00	Inspection, Testing and Inspection Certificates			
9.05.01	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
9.05.02	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
9.05.03	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.			
9.05.04	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.			
9.05.05	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from			
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	proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.		
9.05.06	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.		
9.05.07	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.		
9.05.08	To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.		
9.05.09	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.		
9.06.00	Associated Document for Quality Assurance Programme:		
9.06.01	List of items requiring quality plan and sub supplier approval.	Format No.: QS-01-QAI-P-01/F3-R0	
9.06.02	Status of items requiring Quality Plan and sub supplier approval.	Format No.: QS-01-QAI-P-02/F1-R0	
9.06.03	Field Welding Schedule	Format No.: QS-01-CQA-W-11/F1-R0	
9.06.04	Manufacturing Quality Plan	Format No.: QS-01-QAI-P-09/F1-R0	
9.06.05	Field Quality Plan	Format No.: QS-01-QAI-P-09/F2-R0	
10.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES		
	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected		
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	jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included elsewhere in the Technical Specifications. (b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness. (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SCL (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable. (g) Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain : (1) Biodata including experience of the Commissioning Engineers. (2) Role and responsibilities of the Commissioning Organisation members. (3) Expected duration of posting of the above Commissioning Engineers at site.			
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10.02.00	Initial Operation a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours. c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility. d) The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. e) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.			
11.00.00	GUARANTEE TESTS a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, Start-up Engineer shall make the unit ready to conduct such test. Such test will be commenced, within a period of three (3) months after the successful completion of Initial Operations. Any extension of time beyond the above three (3) months shall be mutually agreed upon.			
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	b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Employer shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost. e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specification.			
12.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests, other than Guarantee Tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.			
13.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover: (a) Working platforms should be fenced and shall have means of access. (b) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.			
14.00.00	NOISE LEVEL The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for			
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	(a) Safety valves and associated vent pipes for which it shall not exceed 105 dBA. (b) Regulating drain valves in which case it shall be limited to 90 dBA. (c) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 85 dBA.			
15.00.00	PACKAGING AND TRANSPORTATION All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.			
16.00.00	ELECTRICAL ENCLOSURE All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification,			
17.00.00	INSTRUMENTATION AND CONTROL All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.			
17.01.00	All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale. All scales and charts shall be calibrated and printed in Metric Units as follows: a) Temperature - Degree centigrade (deg C) b) Pressure - Kilograms per square centimetre (Kg/cm²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.			
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	c)	Draught	-	Millimetres of water column (mm wc).
	d)	Vacuum	-	Millimeters of mercury column (mm Hg) or water column (mm Wcl).
	e)	Flow (Gas)	-	Tonnes/ hour
	f)	Flow (Steam)	-	Tonnes/ hour
	g)	Flow (Liquid)	-	Tonnes / hour
	h)	Flow base	-	760 mm Hg. 15 deg.C
	i)	Density	-	Grams per cubic centimetre.
17.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.			
17.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.			
18.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).			
19.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Contractor for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere. Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.			
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20.00.00	TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Contractor. The standard which is to be adopted, will be intimated to the Contractor. (a) Temperature test pockets with stub and thermowell (b) Pressure test pockets			
21.00.00	ELECTRONIC MODULE/COMPONENT DETAILS The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc. It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.			
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	ANNEXURE-1			
	S.NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (SETS)	NO. OF CD-ROMs /FLOPPIES (SETS)
	1.	PLANT DEFINITION MANUAL-	-	3 CD-ROMs
	2.	Drawings "FOR APPROVAL"	8	3 FLOPPIES
	3.	Drawings "FOR INFORMATION"	8	3 FLOPPIES
	4.	Drawings "FINAL DRAWING"	15	3 CD-ROMs
	5.	Drawings "AS BUILT "	15	3 CD-ROMs
	6	DATASHEETS, DESIGN CALCULATIONS, PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i)	For Approval	8	3 FLOPPIES
	ii)	FINAL	15	3 CD-ROMs
	iii)	Analysis reports of equip- ments/ piping/ structures components/ systems employing software packages as detailed in the specifications		
		a) Input	8	3CD ROMS
		b) Output	8	3CD ROMS
		c) Drawings/ Sketches	8	3CD ROMS
	7.	Erection manual "DRAFT"	4 Sets	
	8	Erection manual "FINAL"	4 Sets	3CD ROMS
	9	Operation & Maintenance manual "DRAFT"		
10	Operation & Maintenance manual "FINAL"		3CD ROMS	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	S.NO. DESCRIPTION OF MANUALS	NO OF PRINTS (SETS)	NO. OF CD-ROMs /FLOPPIES (SETS)	
	11 Plant Hand Book "DRAFT"			
	12 Plant Hand Book "FINAL"		3CD ROMS	
	13 Commissioning and Performance	Procedure manual "DRAFT"		
	14 Commissioning and Performance	Procedure manual "FINAL"	3CD ROMS	
	15 Performance and Functional	8	3 FLOPPIES GURANTEES TEST REPORT	
	16 Progress Reports	8	3 FLOPPIES	
	17 Project completion report	15	3CD ROMS	
	18 QA programme including Organi- sation for implement-ation and QA systemmanual (with revision- servicing)	1	1 CD ROM	
	19 Vendor details in respect of pro- posed vendors including contractor's evaluation report.	1	1 CD ROM	
	20 Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, PQR etc.			
	(i) For review/comment	3	1 set floppies	
	(ii) For final approval	4	1 CD ROM	
	21 Welding Manual, Heat Treatment Manuals, Storage & preservation manuals			
	Draft	4 sets		
	Final	4 sets	2 CD ROMS	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	S.NO. DESCRIPTION OF MANUALS NO OF PRINTS (SETS) NO. OF CD-ROMs /FLOPPIES (SETS)			
	22	Monthly Vendor Approval and QP approval status	2	1 FLOPPY
	23	QA Documentation Package for items / equipment manufactured and dispatched to site	2 sets	2 CD ROMS
	24	QA Documentation Package for field activities on equipment / systems at site	2 sets	2 CD ROMS
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ANNEXURE - II

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	PRODUCT DESIGN	Plant Visit	Visit to Manufacturer's Work	Operation & Maintenance of Plant
Steam Generator	Thermal design and hydraulic circulation balance Combustion and Air & gas weight calculation Pressure part calculation Pressure part and strength calculation Tube metal temp. calculation and selection Performance Duct design Pressure part arrangement Equipment and system sizing and selection of mills, fans, airpreheater, soot blowers, dampers, valves heater, soot blowers, dampers, valves, feeders, burners startup system, fuel firing system, fuel firing system, draft plant.	Familiarization with various system and equipment Performance data collection analysis and review O&M feed back Operation history of various equipments and system Failure analysis	Manufacturing process of pressure parts, and equipments Welding process Testing facilities Product development in process Future plan for technology induction R&D work in progress	Control philosophy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues. Familiarization of special maintenance techniques Special tool and tackles familiarization
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	Flow scheme development of air & flue gas, fuel oil, auxiliary steam, main and reheat steam feed water. PRODUCTION DESIGN Layout of over all plant, steam generator area, pressure part arrangements, platforms, equipment, piping and duct, coal pipe, flue gas ducts, bunker arrangement, valves and damper, ESP area, FGD area cable & piping trestles etc. Erection strategies, erection procedures Performance and demonstration tests.			
MANDAYS	120	20	20	20
FGD	Design and Sizing Process Material selection Performance Duct design	Familiarization with various system and equipment Performance data collection analysis and review O&M feed back Operation history of various equipments and system Failure analysis	Manufacturing process Testing facilities Product development in process Future plan for technology induction R&D work in progress	Control philosophy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues. Familiarization of special maintenance techniques Special tool and tackles familiarization
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	Equipment and system sizing and selection of mills, fans, GGH, dampers, valves, feeders, startup system, Flow scheme of FGD plant Erection strategies, erection procedures Performance and demonstration tests.			
MANDAYS	30	7	7	7
CONTROL & INSTRUMENTATION DDCMIS*-Human Machine Interface - Hardware & Operating System	Hardware & Software organization of the system Basis of selection of H/W memory Sizing Operating system features, interface with other system, openness & inter-operability Upgradability System testing features	Operational feedback		
MANDAYS	16	6		

DDCMIS*-Human Machine Interface System Engineering & Application Software	Specific system customization Various system Modules & interface with OS Database organization & development Development of mimics Other application like calculations, logs historical storage functionalities & use	Operation feedback		
MANDAYS	40	6		
DDCMIS* - Control System Hardware	Basic design features for system & its Modules System capabilities & system design Techniques Communication with HMI & other System	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities	
MANDAYS	20	5	10	
DDCMIS*-Control system Application Software	Database structure Organisation & Interface between application program & database Application for implementation of Control functions Study of standard algorithms & Development of new algorithm	Operational feedback	System integration & System capabilities Testing	
MANDAYS	12	4	4	

DDCMIS* - Control Loop Study	General description of closed loop controls of thermal power plant Critical analysis of few control loops e.g., boiler start up control etc.	Specific operational feedback		
MANDAYS	4	2		
DDCMIS*-Burner Management Study	Hardware logic, NFPA/VDE requirements & other safety standards Logics of turbine stress control system Implementation of fail safe philosophy in turbine protection system	Operational feedback	Manufacturing procedure & precautions for handling the system System testing facilities	
MANDAYS	10	3	3	
Furnace and Flame Viewing system ----- Misc. system for SG C&I	Theory & principle of operation Details of software & methods of modification/customisation	Operational feedback		
MANDAYS	6	3		
Electric Power Supply System	Theory & design features		Manufacturing/assembly process Testing Methodology	
MANDAYS	5	2		
Wherever "DDCMIS" is indicated, it will mean SG C&I part of DDCMIS, which is in Contractor's Scope.				

CRITICAL PIPING & POWER CYCLE PIPING	Design familiarization for critical piping of supercritical Plant Optimization study for sizing including pressure drop calculation and selection of single or double lead together with employer's engineers Design and stress analysis of lines with Expansion Joints together with employer's engineers Design and stress analysis of piping systems with two phase flow involving employer's engineers Transient analysis and optimum sizing of feed suction piping together with employer's engineers. Static and dynamic analysis of critical piping including seismic and other occasional load analysis (safety valve blowing condition). A joint activity together with employer's engineers. Study and collection of data pertaining to special welding requirements (pre and post weld heat treatment and electrode selection criteria etc.) of materials used in high temp piping system.	Familiarization with feed back (in super critical plant) on failure analysis and vibration analysis of piping.+ Study of Feed back regarding hanger setting strategies and practice	Cold Setting of spring hanger Cyclic tests carried on spring hangers. Cyclic tests carried on expansion joints. Manufacturing process of critical piping components and appreciation of their testing facilities at shop.	

	Study and collection of data on special requirements in case of welding dissimilar metals and electrode selection criteria			
MANDAYS	45	10	10	
QUALITY ASSURANCE & INSPECTION QA SYSTEM & PROGRAMME	Integrated QA Management System for enhanced reliability of equipments. ● QA system in design, procurement, manufacturing, installation and operation of the equipments/ systems. ● QA system for developing and establishing new processes and vendors. ● System of structured documentation of Engg. And test records	Operating feed backs: ● Co-relation of reliability and performance of the equipment with implementation of QA system. ● Appreciation of use of structured Engg./QA documentation during Operational phase of plant and during RLA studies of plant	● Appreciation of implementation of QA Programmes in various manufacturing, assembly and testing activities. ● Appreciation of developmental activities for new processes and vendors. ● System of prequalification of special processes.	
MANDAYS	20	10	26	
CONTROLS & INSTRUMENTS	Familiarization with control system and instrumentation QA system for manufacture of reliable components	Feedback on performance of C&I System	Manufacturing activities for critical instruments/Items Implementation of testing programme to ensure reliability.	
MANDAYS	6	4	4	

[illegible]

		Project :		Stage :		FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code:						DOC. NO.:				
		Contractor :										REV. NO.:				
		Contractor No. :										DATE :				
		System :										PAGE : OF				
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																
FORMAT NO.: QS-01-CQA-W-11/F1-R0						1/1						Engg. Div. / QA&I				

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.: REV.NO.: DATE: PAGE: OF....	PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:
		SUB-SYSTEM:		

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE, CHP: NTPC SHALL IDENTIFIED IN COLUM "N" AS 'W'	DOC. NO.: REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER			
SIGNATURE			FOR NTPC USE	REVIEWED BY APPROVED BY APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F1-R1

1/1

ENGG. DIV./QA&I

BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-C BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION GTR	PAGE 4 OF 5

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:			
			ITEM :		QP NO.:					
			SUB-SYSTEM:		REV. NO.: DATE: PAGE: OF....					
SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.
		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)				 FOR NTPC USE	DOC. NO.:		REV.....	
MANUFACTURER/ SUB-SUPPLIER		MAIN-SUPPLIER								
SIGNATURE							REVIEWED BY		APPROVED BY		APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F2-R1

1/1

ENGG. DIV./QA&I

BONGAIGAON THERMAL POWER PROJECT (3X250 MW) STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-C BID DOCUMENT NO.: CS-4610-101-2	SUB-SECTION GTR	PAGE 5 OF 5

NTPC Limited

(A Government of India Enterprise)



BONGAIGAON THERMAL POWER PROJECT

(3X250 MW)

GENERAL TECHNICAL REQUIREMENTS

PART - C

SECTION - VI

TECHNICAL SPECIFICATION

FOR

**STEAM GENERATOR WITH
ELECTROSTATIC PRECIPITATOR PACKAGE**

Bid Document No. : CS-4610-101-2

NTPC Limited

(A Government of India Enterprise)



BONGAIGAON THERMAL POWER PROJECT (3X250 MW)

GENERAL TECHNICAL REQUIREMENTS

PART - C

SECTION - VI

TECHNICAL SPECIFICATION FOR STEAM GENERATOR WITH ELECTROSTATIC PRECIPITATOR PACKAGE

Bid Document No. : CS-4610-101-2

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