NTPC Limited

(A Government of India Enterprise)

LOT 1A PROJECTS

(PART –A)

SECTON – VI

TECHNICAL SPECIFICATION

FOR

FLUE GAS DESULPHURISATION (FGD)

SYSTEM PACKAGE

BIDDING DOCUMENT NO. : CS-0011-109(1A)-2

NTPC Limited

(A Government of India Enterprise)

LOT 1A PROJECTS

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

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LIST OF LOT 1A PROJECTS

1. PROJECT INFORMATION- KUDGI-I 3X800 MW
2. PROJECT INFORMATION- LARA-I 2X800 MW
3. PROJECT INFORMATION- GADARWARA-I 2X800 MW
4. PROJECT INFORMATION- DARLIPALLI-I 2X800 MW
5. PROJECT INFORMATION- MOUDA-II 2X660 MW
6. PROJECT INFORMATION- SOLAPUR-II 2X660 MW
7. PROJECT INFORMATION- TANDA-II 2X660 MW
8. PROJECT INFORMATION- NABINAGAR-I 3X660 MW
9. PROJECT INFORMATION- MEJA-I 2X660 MW
10. PROJECT INFORMATION- BARH-I 3X660 MW
11. PROJECT INFORMATION- NABINAGAR 4X250 MW

LOT-IA PROJECTS

SECTION - VI

TECHNICAL SPECIFICATION
FOR
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

THE TECHNICAL SPECIFICATION, SECTION - VI COMPRISE OF THE FOLLOWING PARTS

PART – A

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- V-Q (QUALITY ASSURANCE)

(MECHANICAL)

SUB-SECTION-V-QM1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-V-QM2	LIME & GYPSUM HANDLING
SUB-SECTION-V-QM3	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-V-QM4	AIR CONDITIONING & VENTILATION
SUB-SECTION-V-QM5	ZERO LIQUID DISCHARGE SYSTEM
SUB-SECTION-V-QM6	COMPRESSOR AIR SYSTEM

(ELECTRICAL)

SUB-SECTION-V-QE1	MOTORS
SUB-SECTION-V-QE2	MEDIUM VOLTAGE BUS DUCTS
SUB-SECTION-V-QE3	LT POWER CABLES
SUB-SECTION-V-QE4	CONTROL CABLES
SUB-SECTION-V-QE5	CABLING EARTHING & LIGHTNING PROTECTION
SUB-SECTION-V-QE6	HT CABLES
SUB-SECTION-V-QE7	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS
SUB-SECTION-V-QE8	HT SWTIGCHGEAR
SUB-SECTION-V-QE9	LT SWTIGCHGEAR
SUB-SECTION-V-QE10	DIESEL GENERATORS
SUB-SECTION-V-QE11	AUXILIARY TRANSFORMERS
SUB-SECTION-V-QE12	ELEVATOR
SUB-SECTION-V-QE13	VFD MODULE
SUB-SECTION-V-QE14	STATION LIGHTING

(CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-V-QC1	MEASURING INSTRUMENTS (PRIMARY & SECONDARY
SUB-SECTION-V-QC2	PROCESS CONNECTION & PIPING
SUB-SECTION-V-QC3	INSTRUMENTATION CABLES
SUB-SECTION-V-QC4	CONTROL DESK PLC PANEL SMOKE DETECTOR FIRE ALARM & CONTROL SYSTEM
SUB-SECTION-V-QC5	POWER SUPPLY SYSTEM
SUB-SECTION-V-QC6	CONTROL VALVE ACTUATORS AND ACCESSORIES
SUB-SECTION-V-QC7	ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS

(CIVIL WORKS)

SUB-SECTION-V-QD1

SUB-SECTION- VI

(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS)

PART - C

GENERAL CONDITIONS OF CONTRACT

PART - D

ERECTION CONDITIONS OF CONTRACTS

PART - E

LIST OF TENDER DRAWINGS

PART - F

ATTACHMENT-12 TO SECTION-VII (TECHNICAL DATA SHEETS)

PART – A

SUB-SECTION-I

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 for each project of Flue Gas Desulphurisation (FGD) System Package for Lot 1A Projects 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) Basic Engineering of the plant including preparation of Plant Definition Manuals for the Project;

b) Detailed design of all the equipment and system(s) including civil, structure steel works included in bidder's scope for the Project.

c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information;

d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required;

e) Complete manufacturing including shop testing/type testing;

f) Complete Civil, Structural and Architectural works, including survey, providing construction offices, field laboratory and construction equipments;

g) Packing and transportation from the manufacturer's works to the site including customs clearance & port clearance, port charges, if any.

h) Receipt, storage, preservation, handling and conservation of equipment at the site;

i) Fabrication, pre-assembly, if any, erection, testing, commissioning and completion of facilities including putting into satisfactory operation all the equipment including successful completion of initial operation;

j) Reliability tests, performance and guarantee tests after successful completion of facilities;

k) Furnishing of spares on FOR site basis;

l) Reconciliation with customs authorities, as required.

m) Satisfactory conclusion of the contract.

n) Insurance and other requirements for the complete FGD package in accordance with the provisions of general conditions of contract (Section-IV) of the bidding document.

1.02.00 The requirements, conditions, appendices etc. given in Technical Specifications (Section-VI, Parts A, B, C, D, E & F and shall apply to and shall be considered as a part of this volume as completely as if bound here with. 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 VI) 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 standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the 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 the specification.

Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specification. Before, submitting their offer, Bidder is required to visit the Project site for assessing the feasibility & layout for FGD System. 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 equipment's covered in this specification:**
1.03.01	Wet limestone based Flue gas desulphurization (FGD) for the project, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler, complete with all accessories and auxiliary equipment's as per specification requirements including Booster Fans for each unit, Absorber for each unit with Slurry re-circulation pumps & Oxidation blowers, common Limestone Grinding & slurry preparation system, common Gypsum dewatering system, Limestone handling and storage system, Gypsum handling and storage system.
1.03.02	One (1) number of elevator for each absorber and One (1) numbers of elevator for Limestone Grinding System building.
1.03.03	Buildings for Slurry re-circulation pumps/Oxidation blowers, Limestone Grinding System, Gypsum dewatering system & FGD control Room.
1.03.04	All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set (if applicable), cabling, lighting etc.
1.03.05	ZERO LIQUID DISCHARGE (ZLD) SYSTEM for FGD waste water for Barh-I (3X660 MW) & Nabinagar (4x250 MW).
1.03.06	Low Height Wet Chimney(s) for the project.
1.03.07	Associated Control & Instrumentation (C&I) equipments.
1.03.08	Associated Civil, Structural and Architectural works including foundation as specified in Technical Specification.
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	**Additional Requirements**
	(a) Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other

circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer.

(b) Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the contractor at his own cost to the satisfaction of the Employer. The contractor shall also take all necessary safety measures with specific reference to excavation in rock, at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power plant.

(c) For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Porta cabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look.

(d) In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, contractor shall use ash and ash based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also 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 ash and ash based products along with each bill.

(e) Contractor shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like piling rigs, cranes batching plant, dewatering pumps etc.) In case of piling rigs, cranes, batching plant etc. he will also make arrangements / tie up with equipment manufacturers / suppliers for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.

3.00.00 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) SCHEMES

Sl. No	Drawings Title	Drawings No.	Rev. No.	No. of Sheets
1)	Scheme of Absorber system	0011-109-POM-A-001	A	2
2)	Scheme of Limestone Milling system	0011-109-POM-A-002	A	1
3)	Scheme of Gypsum De-watering system	0011-109-POM-A-003	A	1
4)	P&ID Diagram for ECW System of FGD	0011-109-POM-A-004	A	1
5)	Process Flow Diagram for FGD Waste water treatment (FGD WWT) for ZLD	0011-109-POM-A-005	A	3

(B) CONTROL & INSTRUMENTATION

Sl. No.	Drawings Title	Drawings No.	No. of Sheets
1.	Standard configuration diagram for PLC	0000-151-POI-A-013	1
2.	G.A. of Junction Box	0000-999-POI-A-017	1
3.	Instrumentation cabling diagram grounding scheme for cabinets/panels/Power Supply	0000-999-POI-A-019A	2
4.	Scheme of 24V DC Power supply system	0000-999-POI-A-019B	1
5.	Scheme for Uninterruptible Power Supply System	0000-999-POI-A-019C	1
6.	Instrumentation/control/power supply cabling diagram	0000-101/102-POI-A-021	3
7.	Instrument Source Connection details	0000-999-POI-A-035	14
8.	Typical GA of Local Instrument	0000-999-POI-A-036	1

Sl. No.	Drawings Title	Drawings No.	No. of Sheets
	Enclosure, purging scheme, DP transmitter		
9.	Interfacing of actuators	0000-999-POI-A-063	1
10.	Interfacing of field instruments/Electrical interface/PLC Interface	0000-999-POI-A-065	15

(C) ELECTRICAL

(1) Electrical single line diagram for FGD Package : Drg No. 0011-109-POE-J-001/A-E

Note : All the above drawings are indicative of Employer's 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 flexibility of operation and maintenance desired by the schemes and layouts shall be binding.

Electrical drawings (except Electrical single line diagram) are attached with respective Electrical Chapters in Part b, Section VI.

4.00.00 QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS

4.01.00 **Provenness criteria for critical equipment, auxiliaries, systems and bought out items:**

The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

4.01.01 Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder:

Type and Rating for Qualification

Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum)
(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Recirculation Pump
(c)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Oxidation Blower
(d)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Ball mill capacity with pulverizing fineness not less than 90% thru 325 mesh
(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Pump(s)
(f)	Agitators	Vertical/Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher size unit for similar application
(g)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Vacuum Belt filter capacity

	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. The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.01 (a) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment.
4.01.02	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01 (a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 660 MW units also, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (a) above for the Booster Fans.
4.01.03	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.
4.01.04	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.01 (c) above but is a manufacturer of Blowers/compressors for minimum 50 NM^3/min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (c) above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.
4.01.05	**(i)** In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.01 (d) above but is a manufacturer

	of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Wet limestone Grinding mills. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project. **OR** **(ii)** In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 4.01.01 (d) above, but have designed, manufactured & supplied dry Grinding Ball Tube mills for at least 500 MW pulverized coal fired power plant, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills. In such a case Bidder shall provide an additional on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.
4.01.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.01 (f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (f) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.
4.01.07	In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.01 (e) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps,

	provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (e) above for the Slurry Recirculation Pumps. **Before** taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.
4.01.08	Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.
4.01.09	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified.
4.01.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.
	Note to clause 4.01.01 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.
4.02.00	**Sub QR for Civil Works:**
4.02.01	Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.
4.02.02	Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 4.02.01. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.

4.02.03	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.
4.02.04	In case Bidder or its agency do not meet the requirements at 4.02.01and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels) for which it is being engaged. Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them. **Design agency for Civil & Steel Structural Works:**
4.02.05	Bidder or its agency (ies) should have carried out the design and detailed engineering of following works: (i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant. (ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. (iii) Machine foundations such as Mill foundations/ Block foundations.
4.02.06	Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 4.02.05. The design agency (ies) proposed by the Bidder shall be subject to Employer's approval.
4.03.00	**PROVENNESS CRITERIA FOR ELECTRICAL EQUIPMENTS**
4.03.01	**HT MOTORS**
4.03.01.01	**BOOSTER FAN MOTOR** The offered Squirrel cage Induction motor shall be from such a Manufacturer who has manufactured and supplied motor of 4MW or above rating, which should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.

4.03.02	**LT SWITCHGEAR**
4.03.02.01	**ROUTE 1**
4.03.02.01	(i) Bidder/ Sub Vendor should have manufactured and supplied at least a total of four hundred & fifty (450) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for 1 second and 105kA peak under a single order and these panels should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.02.01	(ii) Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) nos. of Air Circuit Breakers having fault rating of at least 105kA MAKING and 45kA BREAKING, and their associated draw out type Air circuit breaker panels having fault rating of at least 45kA for 1 Second and 105kA peak, which should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.02.02	**ROUTE 2**
4.03.02.02	(i) Bidder/Sub-vendor should have manufactured and supplied at least a total of two hundred & twenty five (225) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for 1 second and 105kA peak under a single order and these panels should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.02.02	(ii) Bidder/Sub-vendor should have manufactured and supplied at least seventy five (75) nos. of draw out type Air Circuit Breaker panels having fault rating of at least 45kA for 1 second and 105kA peak, which should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.02.02	(iii) Bidder/Sub-vendor shall Associate/Collaborate with a manufacturer who meets the requirements stipulated in Route 1. In such a case, Bidder/Sub-vendor should furnish a Deed of Joint Undertaking executed by Bidder/Sub-vendor and its Associate/Collaborator as per the format enclosed in the bidding document in which the Bidder/Sub-vendor and its Associate/Collaborator are jointly and severally liable to the Employer for successful performance of the LT Switchgears under this package. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved Sub Vendor. In case of award, the Associate or Collaborator of the Bidder / Sub Vendor (as applicable) will be required to

	furnish an on-demand Bank Guarantee for INR 1 Million (Indian Rupees One Million only) **per project.** **Note:** Each Single Front Panel shall be counted as one (1) Panel, Double Front Panel as one (1) Panel and Air Circuit Breaker Panel as one (1) Panel.
4.03.03	**11 KV / 3.3 KV SWITCHGEARS** **Route 1**
4.03.03.01	The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels per annum during the last three years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.03.02	The Bidder/ Sub Vendor should have designed, manufactured and supplied at least one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels complete in all respects with fault rating of at least 40kA for one (1) second and 100kA (peak), which should have been in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.03.03	The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 11kV and /or 6.6kV panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. **Route 2** Bidder/ Sub Vendor based on technological support of its Associate or Collaborator, can also participate provided
4.03.03.04	The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels per annum during the last three years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.03.05	The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels complete in all respects with fault rating of at least 40kA for one (1) second and 100kA (peak). The Bidder/ Sub Vendor should have type tested the offered type of panels as specified.

4.03.03.06	The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 11kV and /or 6.6kV panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.03.07	Bidder's/ Sub Vendor's Associate or Collaborator meets the qualifying requirement stipulated at 4.03.03.02 & 4.03.03.03 stipulated under Route 1.
4.03.03.08	Bidder/ Sub Vendor furnishes a Deed of Joint Undertaking jointly executed by it and its Associate/ Collaborator as per format enclosed in the bidding document in which the Bidder/ Sub Vendor and its Associate/ Collaborator are jointly and severally liable to the Employer for successful performance of the MV Switchgears. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved Sub Vendor. In case of award, the Associate or Collaborator of the Bidder / Sub Vendor (as applicable) will be required to furnish an on-demand Bank Guarantee for INR 1 Million (Indian Rupees One Million only) **per project.** **Note:** Equipment designed by the Bidder itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design.
4.03.04	**NUMERICAL RELAYS & NETWORKING**
4.03.04.01	Numerical Relays shall be offered from a Manufacturer who has manufactured and supplied and successfully configured at least 100 No's of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor Protections. These relays should have been in successful operation for at least one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.04.02	The Numerical Relay Network system shall be offered from an Integrator /Manufacturer who has designed and successfully done FAT for a network on IEC 61850 with at least 100 no's of Communicable Numerical Relays reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.03.05	**AUXILIARY OIL FILLED TRANSFORMERS**
4.03.05.01	The Bidder/ Sub-Vendor should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11KV or higher rating oil filled transformers which should have been in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.

	And
4.03.05.02	Bidder/ Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).
	And
4.03.05.03	16 MVA, 11 KV Class or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested. **Note**: i) Two different installations mean two different project sites or two different contracts. ii) Equipment designed by the Bidder/Sub-vendor by itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design.
4.04.00	**FGD WASTE WATER TREATMENT SYSTEM FOR ZERO LIQUID DISCHARGE (ZLD)**
4.04.01	**Route-1**
4.04.01.01	Bidder/Bidder's Sub vendor should have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of FGD Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser, Vapour Compressor) operating in Coal fired unit(s) of power plant, having inlet feed as FGD waste water of TDS not less than 30,000 ppm and treatment capacity of not less than 10 m^3/hr. The above FGD Waste Water Treatment System should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.04.02	**Route-2**
4.04.02.01	The Bidder/its Sub-vendor who do not meet the qualification requirements stipulated at 4.04.01.01 above, may also participate provided the Bidder/its Sub vendor is a contractor who have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser) operating in an Industrial unit which should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder and associates/collaborates with an Associate/Collaborator who in turn fully meets the requirements stipulated at 4.04.01.01 above.
4.04.02.02	Bidder/its sub vendor should also have a valid ongoing collaboration and technology transfer agreement with an Associate/Collaborator meeting requirements of clause 4.04.01.01 above, valid minimum up to the end of the defect liability period of the

contract. In such a case Bidder/Sub vendor can either source the FGD Waste Water Treatment System from such system provider or can itself manufacture/get manufactured, supply and install the FGD Waste Water Treatment System as per the design, manufacturing and installation drawings released by such Associate/Collaborator.

4.04.02.03 The Bidder shall furnish a Deed of Joint Undertaking (DJU) executed by it, its Sub vendor (if applicable) and the Collaborator/Associate and each executant of DJU shall be jointly and severally liable to the Employer for successful performance of FGD waste water treatment system.

The Deed of Joint Undertaking(s) (DJU) should be submitted at the time of placement of order on approved Sub vendor. In case of award, the Associate or Collaborator of the Bidder/Sub-vendor (as applicable) shall be required to furnish an on demand bank guarantee for INR 20 Million (Rupees Twenty Million) for each project.

4.05.00 Provenness criteria for critical equipment, auxiliaries, systems and bought out items for FGD waste water system:

4.05.01 The Bidder/Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

Evaporator/Brine Concentrator, Crystallizer, Mechanical Vapour Compressor, Evaporator feed Heat exchanger, Crystalliser Heat exchanger for FGD Waste Water System for ZLD offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration/licensing agreement), manufactured/got manufactured the respective equipment(s) of the type, application and minimum equipment rating not less than that supplied in FGD waste water application and such equipment(s) should have been in successful operation in at least one (1) coal fired power station for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.

Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
a)	Evaporator/ Brine concentrator	Falling Film	FGD application in Coal fired power plant	Evaporator/Brine concentrator of a FGD Waste water treatment system of capacity not less than 10 m^3/hr.
b)	Crystallizer	Forced circulation	FGD application in Coal fired power plant	Crystallizer of a FGD Waste water treatment system of capacity not less than 10 m^3/hr.
c)	Mechanical Vapour Compressor	Centrifugal	FGD application in Coal fired power plant	Mechanical Vapour Compressor of a FGD Waste water treatment system of capacity not less than 10 m^3/hr.

Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
d)	Evaporator feed Heat Exchanger	Plate type /Tube & Shell type	FGD application in Coal fired power plant	Evaporator feed Heat Exchanger of a FGD Waste water treatment system of capacity not less than 10 m^3/hr.
e)	Crystallizer Heat Exchanger	Plate type/Tube & Shell type	FGD application in Coal fired power plant	Crystallizer Heat Exchanger of a FGD Waste water treatment system of capacity not less than 10 m^3/hr.

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.

4.05.02 A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.05.01 above in India can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.05.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/his sub-vendor(s) must create/have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).

Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its Holding company/Subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/Subsidiary or upto the end of defect liability period of the contract, whichever is later.

4.05.03 In case the Bidder or the proposed sub-vendor is not manufacturer of proven Evaporator/Brine concentrator as per clause 4.05.01 (a) above but is a manufacturer of Evaporator/Brine concentrator for any Industrial unit, the Bidder or the proposed sub-vendor can also manufacture Evaporator/Brine concentrator, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Evaporator/Brine concentrator in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (a) above for the Evaporator/Brine concentrator. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.

4.05.04 In case the Bidder or the proposed sub-vendor is not manufacturer of proven Crystallizer as per clause 4.05.01 (b) above but is a manufacturer of Crystallizer for any Industrial unit, the Bidder or the proposed sub-vendor can also manufacture Crystallizer, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Crystallizer in India with such

	manufacturer who meet the requirements stipulated at clause 4.05.01 (a) above for the Crystallizer. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.
4.05.05	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Mechanical Vapour Compressor as per clause 4.05.01 (c) above but is a manufacturer of Compressor, the Bidder or the proposed sub-vendor can also manufacture Mechanical Vapour Compressor, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Mechanical Vapour Compressor in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (c) above for the Mechanical Vapour Compressor. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.
4.05.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Evaporator feed Heat Exchanger as per clause 4.05.01 (d) above but is a manufacturer of Heat exchanger, the Bidder or the proposed sub-vendor can also manufacture Evaporator feed Heat Exchanger, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Evaporator feed Heat Exchanger in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (d) above for the Evaporator feed Heat Exchanger. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.
4.05.07	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Crystallizer Heat Exchanger as per clause 4.05.01 (e) above but is a manufacturer of Heat exchanger, the Bidder or the proposed sub-vendor can also manufacture Crystallizer Heat Exchanger, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Crystallizer Heat Exchanger in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (e) above for the Crystallizer Heat Exchanger. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.
4.05.08	Before taking up the manufacturing of such equipment(s) as per clause 4.05.03, 4.05.04, 4.05.05, 4.05.06, 4.05.07 above, the Bidder/its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator/licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator/licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.

4.05.09	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified.
4.05.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.
	Note to clause 4.04.00 & 4.05.00 Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.
4.06.00	**Agency for Wet Stack Flow Model Study** Wet Stack Flow Model Study shall be carried out by an agency which has successfully performed at least two (2) flow model studies, in separate coal fired power plants, of wet stack installed after wet limestone based FGD Absorber (without reheating of cleaned flue gas), and based on the studies developed at least two (2) wet stack liquid collection systems which are in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.
4.07.00	**Balance equipments/ systems** The Bidder at his option can source the balance of plant equipment/systems not covered in clause 4.01.00, 4.02.00**,** 4.03.00, 4.04.00, 4.05.00 & 4.06.00 above. However for such balance of plant equipment/systems, the Employer reserves the rights to satisfy himself on the provenness of the equipment and capability and capacity of the manufacturers.
4.08.00	Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the Bidder/his collaborators/ licenser/ his sub-contractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.
4.09.00	To enable the approval of sub-vendors, the Bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc.

SUB-SECTION-II

PROJECT INFORMATION

(CHAPTERS FOR EACH 11 PROJECTS ENCLOSED SEPERATELY)

SUB-SECTION-III

SCOPE OF SUPPLY & SERVICES

1.00.00 **SCOPE OF SUPPLY AND SERVICES**

The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, engineering, manufacture, inspection and testing at supplier's works, packing, forwarding to site, unloading, pre- assembly, assembly, 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.

1.01.00 The scope of supply & services is detailed out in the following Sub-Sections.

Sub-Section

III A	-	Mechanical equipment and associated systems
III B	-	Electrical Systems
III C	-	C&I systems
III D	-	Civil works

1.02.00 Scope of supply of the Contractor includes mandatory spares, start-up and commissioning spares and consumables. The general requirements in respect of various types of spares is given in Sub-Section-VII, Part-A of Technical Specification.

1.03.00 **Tests**

The scope of the Bidder includes all shop tests, type tests, site tests, routine tests, etc., fulfillment 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.

1.04.00 **Paints / Painting**

The Contractor's scope of work includes supply of paints and painting of all equipments 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 conforming to the requirements stipulated below shall be provided.

(i) Surface preparation shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard.

(ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.

(iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.

(iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat *of* polyurethane of minimum DFT of 25 microns shall be provided.

1.05.00 **Pre-commissioning and Commissioning Activities**

1.05.01 Contractor's Scope shall include all pre-commissioning and commissioning activities, required for successful performance of all equipments and systems under this package. Contractor's scope shall also include supply of all materials and services including the following for successful conductance of pre-commissioning and commissioning activities:

1.05.02 Complete pre-commissioning work including tests of facilities and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.

1.05.03 Commissioning and initial operation of the facilities.

1.05.04 Supply of all consumables as may be required for above pre-commissioning/ commissioning activities

1.05.05 Supply of all temporary equipment such as piping including supports, valves, blowers and all necessary instrumentation for successful conductance of pre-commissioning and commissioning activities. All temporary equipments, blowers, valves etc. brought to sites, by the Contractor for pre-commissioning/commissioning purpose shall be in good working condition to ensure its safe and reliable operation at site. All such temporary equipments/components shall be brought to site at least three (3) months prior to commencement of relevant pre-commissioning/ commissioning activities. On receipt of the temporary equipments/components at site, the same shall be inspected by the Employer to ensure its safe and reliable operation and if in the opinion of the Employer the temporary equipments/ components are not in satisfactory conditions to ensure it's safe and reliable operation the same shall be immediately replaced by the Contractor.

1.05.06 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.

1.05.07	The selection of material of all the temporary equipments/ instruments shall be compatible with the service conditions expected during pre-commissioning/ commissioning activities.
1.05.08	All temporary equipments and instruments shall be clearly listed out in the bid.
1.05.09	Supply of all labour, skilled/ semi skilled supervisors, engineers and any other manpower.
1.05.10	The scope of Contractor shall also include necessary approach & Platforms for all the instruments required during commissioning and testing. These approach platforms shall be provided to meet all required safety norms and these shall be permanent nature.
1.06.00	**First Fill of Consumables, Oils & Lubricants** All the first fill and one year's topping requirements of consumable such as grease, oil, lubricants servo fluids 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 Contractor, unless specifically excluded under the Exclusions in these specifications and documents. Limestone shall be supplied by the Employer.
1.07.00	**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 Contractor, free of cost. All costs associated with the tests shall be included in bid price.
1.08.00	**Spare Parts** The Contractor's scope of supply includes all the necessary commissioning spares, mandatory spares as described Sub-Section-VII / Part-A 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.
1.08.01	**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 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 spares items, the cost

of such spars 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

1.08.02 **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 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.

1.08.03 **Commissioning Spares**

It will be the responsibility of the Contractor to assess and furnish a list of all commissioning spars required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Contractor within 8 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.

1.08.04 **Packing & Preservation**

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 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.

1.09.00 **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 Contractor shall be supplied by the Contractor. 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 along with the offer.

1.10.00 The scope of the Contractor 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.

1.10.01 Bidder shall furnish all relevant data required by the Employer, at interface points within 45 days of notification of award.

SUB-SECTION-III-A

MECHANICAL EQUIPMENTS & SYSTEMS

SUB-SECTION-III-A1

FLUE GAS DESULPHURISATION SYSTEM

SCOPE OF SUPPLY

1.00.00 The contractor's scope of supply shall include engineering, design, manufacture, 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 **Lot 1A Projects**, as detailed in this specification. Steam generator (in Employer's scope) shall be super-critical, balance draft, dry bottom, pulverised coal fired type. The characteristics of the coal, ash and other relevant design data is given in Part-A, Sub section-V of 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 Electrical & 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 equipment/valves/dampers shall be in the contractor's scope. Complete Civil works, structures, foundation required for all the equipment etc. is included in the contractor's scope of work. The contractor shall also include all supporting and structural works, like pipe trestles, platforms, staircases 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 and common gypsum dewatering system for each **Lot 1A** Project. The contractor shall also supply an auxiliary absorbent tank, common for the two units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers, common 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 0011-109-POM-A-001/002/003 (4 sheets). All ducting, dampers, expansion joints, pumps, valves, supports, structures etc. as required for completeness of system of absorbers, common limestone grinding system & common gypsum dewatering system shall also be in the scope of the contractor for each **Lot 1A** Project.

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 terminal point on ID fan discharge duct shall be taken directly to the absorber through Booster Fans. 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 or Jet Air Sprager or any other proven system as per the practice of the FGD vendor.
2.04.00	Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. The contractor shall terminate the flue gas duct (at a suitable point on the common flue gas duct to chimney-upstream of the chimney terminal point and outside the chimney). Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper & Gate is included in the scope of the Contractor.
2.05.00	Limestone to the absorbers of the units shall be supplied by a wet limestone grinding system, common for the units. Limestone shall be fed to the Limestone day silos which in turn will feed the Limestone to wet ball mill through a gravimetric feeder. The classified limestone slurry from the mills shall be stored in two (2 no) limestone slurry storage tanks to be provided by the contractor, from where the slurry shall be pumped to the individual absorbers by dedicated limestone slurry pumps.
2.06.00	The gypsum from the absorber(s) shall be pumped by dedicated gypsum bleed pumps to a common Gypsum Dewatering system consisting of two streams (2x100%) of primary and secondary hydrocyclone and vaccum belt filters for gypsum dewatering. 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 at required pressure to waste water terminal point as indicated in Sub-section IV, Part A of the Technical Specification. Contractor shall provide complete automated waste water neutralization system along with automated lime feeding and dosing system to ensure required pH of waste water is ensured before being discharged at the terminal point. However, for Barh-I (3X660 MW) & Nabinagar (4x250 MW) where separate ZLD system for waste water treatment is being provided by the contractor, separate waste water neutralization system is not required to be provided. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (in Employers scope). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided by the Employer.
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 AND SLURRY PREPARATION SYSTEM (COMMON FOR ALL UNITS) FOR EACH LOT 1A PROJECT**
3.01.00	The contractors scope shall include a common limestone grinding system for all the units and shall comprise of:
3.01.01	2X100% Limestone storage silos each having minimum 24 hours storage capacity equivalent to the requirements of all the units. The storage silo shall be complete with supporting steel structure, platforms, staircase, air canons, power operated gates, gravimetric feeders, level switches, air relief devices, etc.
3.01.02	2x100% wet horizontal ball mills with each mill sized to meet 110% of the maximum total limestone requirement of all the units at Design point.
3.01.03	Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement for of all the units at Design point, complete with all accessories and Agitator(s).

3.01.04	2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank (total 4 nos. of pumps for 2x800 MW). Each pump catering to slurry requirement of each unit's absorber.
3.01.05	Limestone slurry piping to each absorber, along with recirculation lines, all isolation and control valves.
3.01.06	Each mill shall be fed from an independent Limestone bunker. 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/central 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 appropriate lubricating medium storage facility (i.e. 1 no. lube oil tank for storage of lube oil and/or 1 no. grease storage drum as required). 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.
3.01.07	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.
3.01.08	The complete Limestone Grinding System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase & one (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for easy access & movement of man/materials. etc. The building shall be sufficiently ventilated.
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	Absorber tower complete with re-circulating slurry spray header(s) and nozzles, three 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.

4.01.02	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. In case the contractor offers a single level of spray, one number of standby pump of the same capacity & head as the working slurry recirculation pumps shall be provided. (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.)
4.01.03	Complete Ducting System from ID fan common outlet duct to absorber tower & from absorber outlet to wet stack chimney.
4.01.04	2x100% Centrifugal/ positive displacement type oxidation blowers / compressors.
4.01.05	1 No. Emergency water tank for spraying water at inlet of Absorber for upset condition.
4.01.06	All connecting piping and valves required by the system.
4.01.07	2x100% gypsum bleed pumps.
4.01.08	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves.
4.01.09	Routing of the duct/piping system complete with supports, structures, trestles, absorber platforms, as required shall be in the contractor's scope of supply.
4.01.10	Passenger cum Goods elevator for each Absorber of minimum capacity of 1000 kgs.
4.01.11	All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. The building shall be sufficiently ventilated.
5.00.00	**GYPSUM DEWATERING SYSTEM**
5.01.00	The employer envisages a common gypsum dewatering system for all the units. The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of two sets of dewatering equipments.
5.02.00	Each set (suitable for handling /dewatering of all the unit) of dewatering equipment (01 working set + 01 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. One set of secondary hydro-cyclones vi. Complete piping and valves for the system along with wash water line.

5.03.00	This system shall be comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating simultaneously at Design Point, with any range of limestone specified. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.
5.04.00	The filtrate water from belt filter dewatering and wash water from washing system and the under flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank. 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) 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 gypsum slurry from each Absorber shall be fed to a common Primary hydro cyclone feed tank (sized for minimum 1 hr storage capacity) from where it will be fed to each primary set of hydro-cyclone through 2x100% Primary hydro cyclone pumps. The overflow from the primary set of hydro-cyclone shall be taken to a common Secondary hydro cyclone feed tank. 2x100% Secondary hydro cyclone pumps shall be provided to feed 2x100% secondary hydro-cyclones. The underflow from the primary hydro-cyclone shall be fed to the 2X100% vacuum belt filter system.
5.06.00	The under flow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water neutralization system to be provided by the Contractor. The waste water system shall be complete with lime feeding & storage system, neutralization tank, waste water tank, 2x100% waste water pumps along with complete piping, instrumentation, valves, piping support etc. to discharge waste water at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. All the piping with supports, trestles as required shall be in the contractors' scope. The contractor shall also include any other item not included above but necessary to make the system complete.
5.07.00	The complete Gypsum Dewatering System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways for easy access & movement of man/materials etc. The building shall be sufficiently ventilated.
6.00.00	**AUXILIARY ABSORBENT TANK**
6.01.00	The employer shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit.
6.02.00	The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 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 & COOLING WATER STORAGE & PUMPING SCHEME (FOR 2X800 MW)**
7.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of all the units) along with two numbers of 2x100 % Booster water pumps, if required,

	(Each pump catering to the process water requirements of all the units) along with all necessary piping, valves, control & instrumentation to feed the tank from terminal point. Process water Storage level is automatically controlled at operating level by controlling the water flow from the Cooling Tower Blow down System from terminal point. The two tanks shall be interconnected with an isolation valve.
7.01.01	2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit.
7.02.00	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of one unit. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator.
7.03.00	One (1) clarified water Storage tanks (each tank catering to the clarified water requirement for all the units) along with two numbers of 2x100 % clarified Booster water pumps (Each pump catering to the clarified water requirements for all the units) from terminal point.
7.04.00	2x100% cake washing Pumps for each Vacuum Belt Filter.
7.05.00	2x100% cloth washing Pumps for each Vacuum Belt Filter.
7.06.00	Any other pump or storage system not specified but required to meet the system requirement shall be provided by the contractor with the approval of the Employer.
7.07.00	All drains & overflow lines from the tanks shall be terminated to the nearest trench/drain.
7.08.00	All the storage tanks shall be lined with vinyl ester based flake glass lining from inside.
8.00.00	**SUMP & SUMP PUMPS**
8.01.00	The contractor shall provide sumps of adequate capacity in each of the following area: A. Each Absorber Area B. Limestone Grinding system C. Gypsum dewatering system Waste water which might be generated during flushing and cleaning procedures of the equipment shall be collected in the sump and shall possibly be reused in the wet absorber.
8.02.00	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. The Interior surface of the Sumps shall be lined with replaceable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness.

9.00.00	**Elevator**
9.01.00	One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for each Absorber (to be provided in case height of absorber is higher than 20m) and One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs in Limestone Grinding System Building shall be provided for easy access & movement of man/materials.
9.02.00	The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS: 14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include provision of fireman's switch.
9.03.00	One (1) nos. adequately sized, Air conditioners each having minimum cooling capacity of 2.5 Ton shall be provided for each elevator machine room to make it dust proof.
9.04.00	Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection.
9.05.00	To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby.
10.00.00	**Thermal Insulation, Lagging, Cladding & Refractories**
	Thermal Insulation alongwith aluminum cladding, lagging, reinforcement wiremesh, cleats and supports, shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius. The insulation thickness shall be designed based on criteria specified in Part-B, Section-VI.
11.00.00	**Buildings**
11.01.00	Contractor shall provide buildings for Limestone Grinding System; Slurry re-circulating pumps & Oxidation blowers / Compressors; Gypsum Dewatering System & FGD control room & Analyser room (if required). The buildings must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipments of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.
12.00.00	Contractor shall provide Corrosion protection painting for structures & equipments as described in the specification
13.00.00	Contractors scope shall include all Platforms, walkways, staircase, safety rails for access of each equipment, valves, dampers, gates, instruments etc. handling facilities adequately each component of FGD system.
14.00.00	The contractor scope shall also include the provision of FGD trestle for routing of air & water lines, slurry lines, steam line, waste water, etc.. required for the complete process operations.
15.00.00	Contractor shall provide air conditioning for the FGD control room and Analyser room (if separately provided) & ventilation for the FGD system buildings as detailed in Sub-Section III-A2.

16.00.00	Contractor shall provide compressed air system for the FGD system as detailed in Sub-Section III-A3.
17.00.00	Contractor shall provide FIRE FIGHTING SYSTEM as detailed in Sub-Section III-A4.
18.00.00	Contractor shall provide EQUIPMENT COOLING WATER SYSTEM as detailed in Sub-Section III-A5.
19.00.00	Contractor shall provide Limestone & Gypsum handling & storage system for FGD as detailed in Sub-Section III-A6.
20.00.00	Contractor shall provide ZERO LIQUID DISCHARGE SYSTEM for FGD waste water for Barh-I (3X660 MW) & Nabinagar (4x250 MW) as as detailed in Sub-Section III-A7.
21.00.00	The scope of civil works shall be as per Sub-Section-III D.
22.00.00	Associated Electrical and Control & Instrumentation systems for FGD as detailed in Sub-Section-IIIB & Sub-Section-IIIC respectively of Part-A/Section-VI of this specification.
23.00.00	**Booster Fan & Isolation Gates**
23.01.00	For each unit, two (2) nos. Booster Fans of axial type, Constant speed, variable pitch controlled each with drive motor, base plates, foundation bolts and nuts, inlet box, discharge case, coupling, coupling guard and suitable arrangement to prevent rain water entry to fan motor. Each Booster Fan shall be provided with bearing lubrication and hydraulic blade pitch control unit(s) consisting of (1) 2x100% oil pumps each with motor, coupling and coupling guard. (2) 2x100% oil coolers. (3) 2x100% filters, differential pressure switches, etc. (4) One (1) oil storage tank. (5) Instrumentation, vibration monitoring, inter connected piping, valves and fittings including pressure relief valves and non return valves. (6) Electrical actuator with accessories etc. Alternatively, a forced oil lubrication system (consisting of 1to 6 above) common to bearing lubrication and for servo motor operation to each BF Fan will also be acceptable. At least two (02) nos. of duplex thermocouples or duplex platinum RTDs (100 ohm at $0^{o}C$) and one no. of temperature indicators shall be provided for bearing metal temperature measurement, control and monitoring. Booster fans shall be suitable for the type of foundation being provided.
23.02.00	Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at suction & discharge of each Booster Fan. The Gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness without seal air. The gates shall be 100% leak tight with seal air fans under the above conditions.

24.00.00	Contractor shall provide Low Height Wet Chimney(s) as per the criteria & specifications specified elsewhere in the specification for the project.
25.00.00	**Wet Stack Condensate Collection System**
25.00.01	Wet stack of 150 metre height shall be provided with a stack condensate collection system to avoid the carryover of the condensate/acidic dews/water droplets/Gypsum coming out of the stack. Design of the wet stack condensate system should be such that all the condensate are collected in the stack itself and no water droplet/condensate come out of the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the plant/nearby area.
25.00.02	Drain piping shall be of suitable material from corrosion point of view.
25.00.03	All Stack liquid collection shall be easily accessible for O&M.
25.00.04	The design of the stack condensate collection system shall be provided by the bidders in its bid.
25.00.05	A common Nickel based alloy material storage/neutralizing tank for the both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. Storage tank/neutralization tank shall be complete with dosing, mixing and preparation system. After neutralization of the stack condensate collection, same shall be pumped to common drain system. Contractor shall provide 2 X100% pumps, complete with valves, piping fittings, level control/monitoring etc. Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in contact with the condensate shall be of suitable material for the operating duty.
25.00.06	Stack outlet liquid collector shall be designed in such a way so that the liquid condensate film near the exit of the stack is collected instead of carrying with the exit gas. Bidders shall provide all these details in its bid.

SUB-SECTION-III-A2

AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM

1.00.00 **AIR CONDITIONING SYSTEM**

a) General

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Air conditioning system consisting of D-X units with refrigerant piping & valves, Air handling units, Hi-wall split air conditioner /Cassette Air conditioners, Packaged Air Conditioners, Fresh air fans, air distribution system (ducting, filters, isolation dampers, motorized fire dampers, diffusers, grills, volume control dampers, etc.) etc., along with all electrical equipment and instrumentation as required for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.

b) **Air-conditioning system for F.G.D Control Room Building and ZLD control room building (if provided)**

Air cooled condensing units (D-X type) type air conditioners with AHU of suitable capacity with 100 % redundancy (as per actual heat load calculation) shall be provided .

c) SO2 analyzer room (if required) and other air conditioned offices/areas covered under this package shall be provided with Ductable/Non ductable Split air conditioners etc. as per Design criteria specified in Chapter Salient Design Data. Non ductable Split air conditioner shall conform to minimum three (3) star (***) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India.

d) Supply of Mandatory spares as specified.

e) Any additional items required to make the system complete.

f) For Air conditioning system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. The Bidder 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.

g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning system as per manufacturer's standard practice. However relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall be made available in FGD/ ZLD control system. Control and monitoring of air conditioning system from FGD/ZLD control system is also acceptable.

h) Apart from the above, any area/building which are in the scope of the bidder and require air conditioning, the same shall be provided with air conditioning system, as detailed out in Part-B of Technical Specification.

1.02.00 **Redundancies of equipments:**

100% standby unit shall be kept for FGD/ZLD control room, SO2 analyzer room (if required) and other air conditioned offices/areas.

2.00.00 VENTILATION SYSTEM

a) **General**

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Ventilation system consisting of Modular type Unitary air filteration Units, Supply air fans, water pumps, exhaust air fans, louvers, filters, ducting, diffusers, piping, instrumentation etc., for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.

b) **Non-A/C areas of F.G.D Control Room Building and ZLD control room building (if provided)**

Minimum One (1) nos. of Evaporative type Unitary Air Filtration (UAF) unit (of metallic construction- modular type) of suitable capacity with all accessories, DIDW centrifugal fan (1 x 100%), circulating water pump (1 x 100%), etc. as detailed out in technical specification shall be provided.

c) **Miscellaneous areas:** All other areas like Limestone Grinding system building, Gypsum dewatering building, Recirculation pump & Oxidation blower/compressor building etc & all other non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.

d) Supply of Mandatory spares as specified.

e) Any additional items required to make the system complete.

f) For Ventilation system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. 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.

g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of ventilation system as per manufacturer's standard practice. Control and monitoring of ventilation system from FGD /ZLD control system is also acceptable.

3.00.00 COMPRESSED AIR SYSTEM

a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD and ZLD plant (if provided) each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Part A, Sub-section 'Salient design data' of technical specification. However, minimum capacity of each air compressor shall be 15Nm^3/min at discharge pressure of 8.5 Kgf/cm^2 (g).

b) Two (2) numbers (1 working+ 1 standby) Air Drying Plants (one for each air compressor) of adequate capacity with all interconnecting piping, valves, fittings, etc.

c) Two number Air Receiver each of capacity 2 m^3 (normal) at the discharge of each Air compressor.

d) One number Air Receiver of capacity 2m^3(normal) for ZLD plant if ZLD plant is far away from compressor location.

g) Monorail with Chain pulley block of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more.

h) Complete instruments, control system with panels as required for compressed air system.

i) Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided).

j) Supply of Mandatory spares as specified.

k) Any additional items required to make the system complete.

4.00.00 General

i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system.

ii. Set of commissioning spares as may be required during erection and commissioning.

iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipment under the scope of bidder.

iv. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications.

v. Any additional items required to make the system complete.

vi. Initial charge of all lubricants and grease, etc. Further, all consumables required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc.

vii. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls, for executing the works under this system and making them water tight as directed by the engineer.

Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification.

SUB-SECTION-III-A**3**

FIRE FIGHTING SYSTEM

1.00.00 FIRE DETECTION AND PROTECTION SYSTEM:

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Fire Detection and Protection System for FGD area. Following system has been envisaged:

1.1 Hydrant System:

Complete hydrant system (pipe, hydrant valves, landing valves, water monitors, hoses, branch pipes and nozzles etc) for FGD area shall be provided as per TAC norms. Tapping for hydrant system shall be provided from nearby existing hydrant header.

1.2 HVW Spray System:

Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under this package. Tapping for HVW spray system shall be provided from nearby existing hydrant header.

1.3 MVW Spray System:

Automatic fire detection cum medium velocity water spray system for the various cable galleries envisaged under this package. Tapping for MVW spray system shall be provided from nearby existing Spray header.

1.4 Fire Extinguishers

Five numbers each type of Portable fire extinguishers consisting of water type, dry chemical powder type, CO2 type shall be provided in various facilities of FGD system.

1.5 Analogue addressable type Fire Alarm System / Annunciation Panels:

Analogue addressable type Fire Alarm System consisting of Multi sensor type detectors, Linear Heat Sensing Cable (LHSC) detector, cabling, junction boxes, instrumentation, Fire Alarm cum control panels, repeater panels, etc. for various areas/equipment as detailed out below:-

a) All MCC / switch gear room / Control room shall be provided with Multisensor type detectors.
b) All Conveyors and Cable Galleries shall be provided with Linear Heat Sensing Cable detectors.
c) All cable galleries shall be provided with Multisensor type detectors.

1.6 The Contractor is responsible for getting the complete approval of the system elaborated in this specification from TAC accredited professional(s).

1.7 If the contractor feels, it is necessary to include any other items, which, in his opinion, may be required to comply with TAC regulations, other than those indicated in the specification, the same shall also be supplied, erected and commissioned. Any amendments, modified rules to the latest TAC regulations till techno-commercial bid opening date should be considered by contractor to fulfill the above condition.

1.8 Successful contractor shall furnish complete hydraulic calculation.

1.9 Supply of complete mandatory spares as specified elsewhere.

1.10 Set of commissioning spares as may be required during erection and commissioning.

1.11 One (1) set Special tools and tackles required for maintenance of all the mechanical, electrical and C & I equipment under the scope of Contractor.

1.12 Any additional item/ equipment required to make the system complete.

1.13 Grouting, dressing and final finishing of all foundations of various equipment, etc.

1.14 Supply of structural supports for piping in trench and for above ground piping wherever applicable.

1.15 Supply & application of protective coatings and wrapping for buried pipes and pipes in RCC trenches, and painting for above ground piping, valves, pipe supports, etc. as detailed in technical specifications.

1.16 Excavation, preparation of bed, laying, backfilling with compaction of soil for all underground/buried piping. Also, breaking and re-erection of paving for buried piping (if any)

1.17 Preparation of necessary detailed drawings including schematics, layouts, isometrics, fabrication drgs, erection drgs, etc. as required and also development of “As Built Drgs”.

1.18 Conductance of Performance and Guarantee test as per Standard Guaranteed test procedure given elsewhere in the specification.

1.19 All pylons required for transformers, shall be anchored to soak pit base slab of individual transformer, paved area outside soak pit, etc. using anchor fasteners of adequate capacity. Subsequent to fixing the pylons, lower part of pylon which would be within filled up gravel portion shall be encased with concrete by Employer for corrosion protection.

SUB-SECTION-III-A**4**

EQUIPMENT COOLING WATER SYSTEM

EQUIPMENT COOLING WATER SYSTEM

(FOR NABINAGAR - 3 X 660 MW & BARH-I(3 X 660)

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System**

The Bidder shall provide common Equipment Cooling water system for all three units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(a) One cold water header tapped from CW Blowdown from CW pump discharge pipe.

(b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water.

(c) 2x100% capacity self cleaning strainers on the secondary side.

(d) 4 x 33.33% (3 working + 1 standby) capacity of plate type heat exchangers.

(e) 5 x 33.33% (3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.

(f) 4 x 33.33% (3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(g) One Overhead DM water tank (ECW O/H tank).

(h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(i) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

EQUIPMENT COOLING WATER SYSTEM
(FOR NABINAGAR TPP- 4 X 250 MW)

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System**

The Bidder shall provide common Equipment Cooling water system for all four units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(b) One cold water header tapped from CW Blowdown from CW pump discharge pipe.

(b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water.

(c) 2x100% capacity self cleaning strainers on the secondary side.

(d) 5 x 25% (4 working + 1 standby) capacity of plate type heat exchangers.

(e) 6 x 25% (4 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.

(f) 5 x 25% (4 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(g) One Overhead DM water tank (ECW O/H tank).

(h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(ii) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

EQUIPMENT COOLING WATER SYSTEM
(FOR LARA STPP- 2 X 800 MW,KUDGI-2 X 800 MW,GADARWARA -2 X 800 MW,DARLIPALI-2 X 800 MW,MOUDA –II 2 X 660 MW,TANDA-II -2 X 660 MW,MEJA-2 X 660 MW,)

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System**

The Bidder shall provide common Equipment Cooling water system for all two units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(a) One cold water header tapped from CW Blowdown from CW pump discharge pipe.

(b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water.

(c) 2x100% capacity self cleaning strainers on the secondary side.

(d) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers.

(e) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.

(f) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(g) One Overhead DM water tank (ECW O/H tank).

(h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(iii) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

SUB-SECTION-III- A**5**

LIME STONE & GYPSUM HANDLING SYSTEM

1.00.00 **INTENT OF SPECIFICATION**

This specification is intended to cover the following activities and services in respect of all the equipment of **Lime Stone Handling Plant & Gypsum Handling plant** to be installed for **FGD Package**, 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", Part-A, Section–VI of Technical Specification.

(i) Detailed design and engineering of all the equipment and equipment system(s).

(ii) Complete manufacture including shop testing/ type testing.

(iii) Providing engineering data, drawings, Commissioning procedures and O & M manuals, etc. for the Employer's review, approval and records.

(iv) Packing and transportation from the manufacturer's works to site including transit insurance, customs clearance/ port clearance, if required.

(v) Receipt, unloading, storage, preservation, conservation and insurance of equipment at site.

(vi) Fabrication, pre-assembly, (if any), erection, testing and putting into satisfactory operation of all the equipment including successful completion of facilities.

(vii) Associated civil, structural, architectural and electrical works.

(viii) Commissioning and completion of facilities and Performance Guarantee Tests after successful completion of initial operation.

(ix) Furnishing of spares on FOR site basis and handing over to NTPC stores.

(x) Reconciliation with custom authorities, if applicable.

(xi) Satisfactory completion of the contract.

1.01.00 Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer.

1.02.01 Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid. ***In the absence of this, the bid shall be deemed incomplete and may be liable for rejection***.

1.02.02	NTPC reserves the right to freeze a basic layout for each NTPC plant post techno commercial bid discussions.
1.03.00	The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of ensuring operability and the reliability of the complete system covered under this specification.
1.04.00	Cleaning of any debris produced by the bidder during erection and commissioning shall be done immediately at each front by the bidder.
1.05.00	Bidder to extend all help and documentary support for compliance and addressing any statutory issues raised at site which pertains to the area/ work under bidder's scope.
2.00.0	**DETAILED SCOPE**
2.01.00	**Limestone Handling Plant (LHP)**
2.01.01	Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes. **Lime stone received through Road** shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 20T capacity to discharge Limestone on to Box Feeders/ Surface Feeders/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers. Two (2) numbers Box Feeders/ Bulk-material Receiving Unit/ Underground Truck Unloading Hopper / Surface feeder, for unloading of limestone from trucks/ self-tippling trucks/ loader shovels, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house. **Limestone received through Indian Railway Rakes** will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house through series of new conveyors/bucket elevators. All necessary modifications involving Mechanical, Electrical, C&I, Civil and Structural works in the existing CHP for taking feed to new limestone path shall be in the scope of the bidder.
2.01.02	Limestone shall be conveyed to usage point through double stream of capacity 100% each for conveying & crushing.
2.01.03	Lime stone Belt Conveyors / Bucket Elevator complete with associated tunnel, conveyor galleries along with its supporting structures, short supports, stringers, deck plate, seal plate, conveyor foundations, drive motors, drive units, pulleys, idlers, gravity take ups including guides, pits etc., internal and external belt cleaners, pull chord switches, belt sway, zero speed switches, electro-hydraulic thruster brakes, all electrical etc. including all civil, structural and architectural works for tunnel, conveyor gallery, gallery supporting trestles and their associated foundations, as applicable.
2.01.04	One (1) number Lime stone crusher house (CH) complete with all civil, structural, architectural and electrical works etc. accommodating suitable nos. crushers and

	associated Vibrating feeders, R&P and Rod gates etc., passenger cum goods elevator, conveyors, chute work along with actuator operated flap gates, monorails & hoists, hoist maintenance platform, external and internal staircases, hand rails and other equipment such as sampling unit, dust extraction system etc. as specified elsewhere.
2.01.05	Suitable numbers of vibrating feeders in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc.
2.01.06	Suitable numbers of hammer crusher complete with drives, accessories all mechanical, electrical civil & structural works, including crusher supporting foundations, vibration isolation system with springs and viscous dampers, vibration monitoring system etc.
2.01.07	Crushed limestone Reclaim Hopper (RH) /Silo, machinery hatches at each of end of limestone storage shed for RH, fully / partially underground or over ground junction towers, tunnels and pent houses, complete with civil, structural, architectural, electrical and C&I works including over ground structural shed for entire length of limestone ground storage and machinery hatches, removable chequered plate covers over openings in machinery hatches for handling underground equipment like paddle feeders etc. (as applicable). For Limestone storage shed and for all buildings, other equipment such as DS system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification.
2.01.08	Junction towers (along with underground / over ground RCC structures), tunnel/conveyor gallery / bucket elevator complete with all civil, structural, architectural, electrical and C&I works including chutes, monorails, hoists/chain pulley blocks, hoist maintenance platforms, external staircases, dust debris chutes etc. All over-ground junction towers shall have separate debris disposal chute up to the ground floor. Underground junction towers shall be provided with machinery hatches along with monorail, electric hoist for handling equipment from underground to over ground.
2.01.09	Complete chute work along with chute block switches and actuator operated flap gates, mobile discharge pulleys (as applicable) in all junction towers between various conveyors.
2.01.10	Suitable number of motorized travelling tripper / flow diverter plough (as applicable) on each feeding conveyor for feeding the crushed limestone to the covered storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc.
2.01.11	One number of covered storage shed for crushed limestone. The storage shed shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design Point (Generation of all units to be considered). A reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum 7 days. Suitable number of Belt feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators.

2.01.12	Two (2) numbers paddle feeders (in case of covered storage shed) complete with all electrical, rails, supporting structures, end stops, cable reeling drums, trailing cables, and necessary arrangement for cabling on floor of reclaim hoppers along with accessories, shall be installed at the bottom of the reclaim hoppers to scoop the limestone from reclaim hoppers and feed limestone on to the underground conveyors.
2.01.13	Two (2) nos. of lime sampling units, one for as received limestone in crusher house and one for as used limestone in TP before feeding to limestone bunkers, complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms, hoists etc.
2.01.14	Suitable number of ploughs and its actuating mechanism shall be mounted on each conveyor to feed limestone into limestone mill bunkers. Alternatively, suitable nos. fixed Trippers on each conveyor to feed limestone into limestone mill bunkers.
2.01.15	Minimum four (4) Nos. sump pumps in limestone storage shed (in case of covered storage shed), and two (2) Nos. sump pumps in all TPs completely or partially underground complete with motors, local control panel, level switches, individual discharge piping with fittings and valves to nearest plant drain including pipes etc. upto disposal point.
2.01.16	Adequate number of ventilation equipment for ventilating the limestone reclaim hopper, underground tunnel of Conveyors, underground portion of Junction towers and limestone bunker bays (housing tripper/plough conveyors) complete with all mechanical, electrical, civil and structural works and associated foundations.
2.01.17	Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works.
2.01.18	Exhaust fans to be provided in all battery rooms and all toilets complete with electrical, civil & structural works etc. Supply and exhaust fans along with required ducting shall also be provided for all underground Structures/junction towers complete with all mechanical, electrical, civil and structural works and associated foundations.
2.01.19	One (1) number of passenger cum goods elevator with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house.
2.01.20	Two (2) numbers of in line magnetic separators (one no. on each conveyor feeding to crusher house) and two (2) number of suspended magnets, (one no. on each conveyor feeding to Limestone bunker (in case of covered storage shed)) on conveyors complete with reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories.
2.01.21	Four (4) numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) complete with all mechanical, electrical, civil, structural works and accessories.
2.01.22	Four (4) numbers of electronic type belt scales (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories.

2.01.23	Complete dust extraction system for control of fugitive dust in limestone storage shed / Silos, junction towers, crusher house complete with fans, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works.
2.01.24	Service water and potable water system for complete limestone handling plant. Water Pump houses & water tanks for service water, cooling water (as applicable) and potable water system.
2.01.25	Cooling water system (as applicable) for scoop couplings, for complete limestone handling plant. Air cooled type scoop couplings are also acceptable.
2.01.26	Monorails and electrically operated hoist blocks as well as hand operated chain pulley blocks for servicing/installation/easy replacement of drive machinery, different types of pulleys for all conveyors, GTU and other equipment from ground level to their locations and vice-versa & landing inside the respective Buildings.
2.01.27	One (1) number of belt vulcanizing machine, suitable for all belt widths in limestone handling system, complete with all mechanical, electrical, accessories and consumables for one year of consumption. Further belt jointing facilities as specified shall be provided.
2.01.28	Minimum one (1) no. Weighing Bridge for Road trucks / Tipplers shall be provided each in Limestone unloading area and in Gypsum Loading area.
2.01.29	All buildings shall be complete with all electrical, civil, structural, architectural works, cable trenches, fire safety walls, foundation, earth mat, fencing, earthing for transformers. All cables, duct banks, trenches, cable trestles shall be complete with associated civil/ structural work and necessary civil foundations.
2.01.30	Drainage of LHP buildings, tunnels, conveyor galleries and limestone storage shed / Silos including all civil & structural works as detailed out elsewhere in the specification.
2.01.31	All equipment/fittings, supporting structure, along with insert plates, bolts, accessories, MS sleeves, base plates, grouting as may be required and proper alignment etc.
2.01.32	Complete un-used set of all special tools and tackles, which are necessary or convenient for erection, commissioning and overhauling of any equipment, covered under the scope.
2.01.33	First fill of all consumables, e.g.; oils and lubricants for one year toppings requirements.
2.01.34	Preservative shop coating, final painting of all structures and equipment.
2.01.35	All inserts, anchor bolts, foundation bolts for Contractor's equipment, platforms etc. in the entire LHP.
2.01.36	All necessary grouting & finishing of the floor after welding at all such pockets & elsewhere is in Contractor's scope.

3.00.00	**GYPSUM HANDLING PLANT (GHP)**
3.01.00	Gypsum shall be conveyed from the vacuum belt filter to the storage shed through a series of double stream conveyors and transfer points/junction towers.
3.02.00	One number of covered storage shed for gypsum. The storage shed shall be sufficient to store gypsum equivalent to gypsum generation of minimum 7 days at Design Point (Generation of all units to be considered).
3.03.00	Minimum four (2) Nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves to nearest plant drain including pipes etc. up to disposal point.
3.04.00	Complete dust suppression system for control of fugitive dust in gypsum storage shed, complete with pumps, water tanks, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works.
3.05.00	Service water and potable water system for complete gypsum handling plant. Water Pump houses & water tanks for service water, cooling water and potable water system. Common pump house for Limestone handling plant gypsum handling plant is also acceptable.
3.06.00	Suitable number of motorized travelling tripper / Flow diverter (as applicable) on each feeding conveyor for feeding the gypsum to the covered storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc.
3.07.00	Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader.
3.08.00	Complete ventilation system for gypsum storage shed.
4.00.00	Bidder to note that the above list is not exhaustive and any work required for integration of complete system and ensuring its satisfactory running shall be in the scope of work and supply for this package.

SUB-SECTION-III- A**6**

ZERO LIQUID DISCHARGE SYSTEM

FGD WASTE WATER TREATMENT (FGD WWT) SYSTEM FOR ZLD

1.00.00 General

1.00.01 A FGD Waste Water Treatment (FGD WWT) System for Zero Liquid Discharge (ZLD) shall be provided by the Contractor for storing, treating and re-using all wastewaters generated from Wet Limestone based FGD system for Barh STPP St.-I (3x660MW) and Nabinagar TPP (4x250 MW) Units. The contractor shall provide evaporative concentration process for FGD Wastewater Treatment Plant to achieve zero liquid discharge (ZLD). The treatment system shall be comprised of the systems like wastewater storage, suspended solid removal, Pre-treatment (including decalcification process), Evaporative concentration, Treated water disposal, Chemical feed, Sludge dewatering etc. The removed impurities from the FGD Waste Water Treatment (FGD WWT) plant will be bound in the form of solid cake, hence allowing the station to be complete ZLD.

1.00.02 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 Contractor's work(s), packing, forwarding to site, unloading, erection, supervision, pre-commissioning, testing, commissioning and performance testing of the equipment/systems indicated hereunder. Items though not specifically mentioned in the specification but needed to complete the equipment and systems to meet the intent of specification, shall also be deemed to be included unless otherwise specifically mentioned under exclusions.

1.01.00 **Wastewater storage, Suspended solid removal process, Pre-treatment system**

Pre-treatment system shall consist of FGD waste water storage tank (2x50%) to store FGD wastewater, GGH washing water etc., Aeration devices, lime, ferric chloride and soda ash unloading, storage, dosing & reaction system for pH adjustment, reaction and coagulation, Clarifier feed pumps, Primary Clarifier (1x100%), Secondary Clarifier (1x100%), Clarified water/Evaporator/Brine Concentrator (BC) feed tank, Evaporator/BC feed pumps, Sludge sumps, Filter press feed pumps, Filter press (2x50%), Filterate water tank, Filterate water transfer pumps, piping, valves, instrumentation etc. to make the system complete.

1.02.00 **Evaporative concentration system**

The softened wastewater shall flow to the evaporation phase of the plant. Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. The Evaporative Concentration system shall be comprised of Evaporator feed tank(s), feed pumps, Evaporator feed Heat exchanger(s), Deaerator(s), Mechanical Vapour Compressor(s), Evaporator(s), Evaporator Recirculation pumps, Distillate tank(s), Distillate Pumps, Vacuum pumps (If applicable), Seeding system, Chemical feeding system, vapour ducts, recirculation ducts, piping, valves, instruments etc. shall be provided as required as per system chemistry to make the system complete.

The Crystallizer (1x100%) system shall be equipped with Crystalliser feed tank, feed pump, Crystalliser Heater, Crystalliser Condenser, Crystalliser distillate pump, Crystalliser Vapour body, Crystalliser Recirculation pump, Crystalliser Condensate tank, Crystalliser Condensate Pumps, Centrifuge feed pump, Centrifuge (2x50%), Centrate tank, Centrate Pump, Anti foaming system, chemical feed system, vapour ducts, recirculation ducts etc. as required as per system chemistry to make the system complete.

Hoist(s) for various vessels in evaporative concentration system, pressure transmitters, level transmitters with root valves, drain pipes equipped with float traps, Y-strainers, bypass valves, shut-off valves etc. shall be provided as per system requirement.

1.03.00 **Chemical storage, dosing system**

Chemical storage and injection equipment comprising of all required chemical feed equipment like chemical storage tanks, chemical dissolving tanks, chemical injection tanks & pumps, agitators, heaters, fume scrubbers etc., necessary chemical unloading/transfer pumps, auto dissolving equipment (if polymer is used), level gauge for all chemical tanks etc., electric heater for caustic tank, electric heat tracing for caustic piping, chemical feed pumps, chemical dosing/injection pumps, all other necessary equipment and accessories etc. as specified and as per system requirement shall be provided to make the system complete.

1.04.00 **Other**

a) Exterior & interior equipment support foundation and foundation accessories such as sole plates, counter flanges with bolts, nuts, gaskets, packing, channel base, sub-sole plates, shims, wedges, foundation anchor bolts and nuts, anchor frame and nuts, grout, embedded materials, etc.

b) Piping and valves including safety and relief valves, hangers and supports etc.

c) All required insulation and lagging materials supply and installation.

d) Lifting devices such as crane, hoist, trolley and monorail, etc.

e) Set of connections, flow element flanges and all other items, required for performance test.

f) Complete lubricating oil system and cooling water system, wherever required.

g) All instruments, instrument nozzles, connections, root valves, sensing lines and their installation materials complete with instrumentation to measure and indicate all fluid conditions.

h) Consumable materials and/or erection spare parts which will be required for storage, installation, start-up, to put the equipments covered under the scope of specifications, into successful commissioning/initial operation and to establish completion of facilities shall be provided by the bidder, unless specifically excluded under the exclusions in the specifications and documents.

i) All the first fill & one year's topping requirement of consumable such as chemicals**,** greases, oil, lubricants, servo fluids etc. which will be required to put the equipments covered under the scope of specifications of Zero liquid discharge (ZLD) Plant for FGD waste water, into successful commissioning/initial operation and to establish completion of facilities shall be provided by the bidder, unless specifically excluded under the Exclusions in these specifications and documents. Suitable standard lubricants as available in India are desired. Effort should be made to limit the variety of lubricants to minimum.

j) All attemperator systems including piping, control valves, isolation valves, check valves and bypass valves.

k) Enclosures for required systems. These include sound, personnel protection, weather and any other enclosures necessary to ensure a complete operating system.

l) Grounding pads with clamps or studs on the equipment.

m) Stairs and ladders, walkways, handrails, platforms and supports for monitoring, operation and maintenance of all equipment furnished by the Supplier.

n) Safety showers and eye washers

o) Sample connections

p) All required modification, replacement, relocation, demolition work of existing facilities.

q) Vinyl esteric resin mortar material for tank lining.

r) All interconnecting piping, piping supports, valves and instrumentation.

s) All support platforms and access (by stairs) shall be provided. This applies to both indoor and outdoor piping/equipment. Ladders shall be used for secondary access only.

t) Stairs shall be able to access all platforms. All exterior steel shall be epoxy black powder coated, no galvanized steel permitted in exterior applications.

u) The contractor shall envisage and provide any additional system as required to meet to make the system complete.

SUB-SECTION-III-B

ELECTRICAL SYSTEM/EQUIPMENT

ELECTRICAL SYSTEM / EQUIPMENT

1.00.00 **GENERAL**

The Contractor's scope shall include design, engineering, manufacture, type testing, inspection & shop testing at supplier's works, packing, forwarding to site including customs clearance/ port clearance (if required), receipt and unloading, in plant transportation, handling and storage (preservation & conservation of equipment) at site, erection including associated civil and structural works, testing and commissioning of the Electrical equipment/ system and works indicated in this chapter. The scope includes all interface/ interconnections with the electrical systems under this contract as required and other systems mentioned elsewhere. Unless explicitly stated to be common for all the units, the Contractor shall provide all system/equipment for each of the units. The Electrical scope shall be as described briefly in the following clauses but not limited to it.

1.01.00 **MOTORS**

Motors along with couplings and coupling guards for all rotating auxiliaries covered under this package.

1.02.00 **HT/ LT SWITCH GEAR**

HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001) Busduct / Cable (as applicable), distribution boards, AC/DC fuse boards, LDB, local emergency push button stations for all drives energized from MCC's under contractor scope and local motor starters (for ventilation fans) as required for plant and equipment in contractor's scope.

1.03.00 **DC SYSTEM**

Battery and Battery Charger

Lead acid plante type/ Nickel Cadmium batteries and Float cum boost chargers for plant and equipment in the scope of the contractor, as per system requirement. The DC system (Battery and Charger) shall be supplied to cater to various DC loads in the plant. The design and sizing criteria shall be as detailed out in the chapter B-0, Part-B of Technical specifications.

1.04.00 **TRANSFORMERS**

Transformers as per Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 and system requirement, however bidder to provide complete sizing & selection criteria of Transformer's feeding Contractor's own systems.

1.05.00 **ELECTRIC ACTUATORS**

Electric actuators with integral starters along with associated accessories etc shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirements.

1.06.00 **CABLES / BUSDUCT**

All HT/ LT power & control cables required for connection between equipment/devices in contractors scope and cables / Busduct (as applicable) between employers and contractors equipment as per Electrical Single Line Diagram Drg No. 0011-109-POE-J-001).

1.07.00 **DG SET (IF APPLICABLE)**

Diesel Generator sets of stationary type comprising the following:

(1.) Diesel Engine Complete with all accessories

(2.) An alternator directly coupled to engine through flexible/rigid coupling complete with all accessories (CT's & VT's etc.)

(3.) Control Panel

(4.) Complete starting arrangement along with battery ,its charger

(5.) Base frame and foundation bolts etc.

(6.) Exhaust ducting meeting the statuary requirements, accessories, support structure and foundation bolts.

(7.) Day Oil Tank, fuel piping and accessories

(8.) Interconnection piping and accessories

(9.) Power and control cable gland and lugs at Bidder's equipment for all cables

(10.) Cable & Cabling between Bidder's equipment.

(11.) All lubricants for first filling, consumables and touch up paints etc for commissioning.

(12.) Acoustic enclosure meeting the statuary requirements. Necessary ventilation along with necessary starters & lighting shall be provided.

1.08.00 **CABLING**

1) Contractor shall provide cable trays and their accessories with support arrangements, trestle, trenches, duct bank etc. as required for the cables under his scope of supply for the complete system. However the Cable tray, supports and tray earthing for contractor cables on employer cable vault shall be supplied by employer.

2) Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011-999-POC-F-001 subject to availability of space and suitability. In case of non availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. Further Contractor shall

supply cables, trestle, trenches, duct bank, cable slit, cable trays and structure etc. from employer trestle to the equipment in FGD area in the contractor's scope.

3) Contractor shall supply, lay and terminate the cables under his scope of supply

4) The contractor shall furnish the complete and consolidated feeder list for DC system, LT system and HT system for all loads and drives under the scope of supply of contractor to employer as per the format enclosed at Annexure-A. Contractor shall indicate the location of his equipment's in feeder load list.

5) Contractor shall provide cable glands and lugs for all equipment's in his scope.

6) Contractor shall provide all accessories such as rigid/ flexible conduits, fittings, junction boxes, tying materials, cable tags, and markers etc. for the cables under his scope.

7) Contractor shall provide Straight-through jointing kits for HT XLPE power cable, LT power and control cables, Cable termination kits for HT XLPE power cables, Welding receptacles, Trefoil cable clamps, Junction boxes.

8) Contractor shall provide Galvanised steel pipes/HDPE/hume pipes/PVC pipes, Miscellaneous items like M.S sections etc as required,

9) Contractor shall provide Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc

10) In addition to other drawings, Contractor shall also prepare complete equipment layout drawings, lighting layout drawings including cable tray layout, routing, Power and control cable schedules etc

11) Control interconnection charts shall also be prepared by bidder

1.09.00 **LIGHTING**

Complete lighting system for internal and external areas for the plant, buildings, chimney and equipment in the bidder's scope. Lighting fixtures complete with lamps & accessories, LED lighting fixture complete with driver circuit & accessories Lighting Panels, Chimney aviation light, Receptacles, Switch boxes. Conduits. Lighting Wires, Ceiling fans with regulators, Lighting poles. Lighting masts, Earth wires and rods, Junction boxes, Battery operated automatic self contained lighting fixture, Maintenance ladders as required are included in the bidder's scope.

Mandatory spare parts and maintenance equipment as required.

1.10.00 **EARTHING AND LIGHTNING PROTECTION**

Complete below ground earth mat and above ground equipment earthing system and lightning protection for the plant and equipment under contractors scope along with its interconnection to the nearest employers earth grid at two points.

1.11.00 **PAINTING FOR ELECTRICAL EQUIPMENT**

The painting of all electrical equipment shall be epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. The Contractor shall furnish the complete painting details during detailed engineering stage.

1.12.00 **CONSTRUCTION POWER**

To meet the construction power requirement of the FGD and associated systems, the Employer shall provide Two Number 415V feeders in LT switchgears. The Contractor shall extend supply from these Construction power feeders to meet the construction power requirements at the various locations included in the Contractor's scope through suitably rated Isolation Transformers along with LT distribution boards as per requirement. LT Packaged Sub-stations with isolation transformers may also be used for this purpose. Suitable metering arrangement along with associated Instrument transformers and Metering Cubicles meeting the DISCOM requirements shall be provided by the Contractor at each Construction power feeder, for the measurement of actual energy consumed by the Contractor. The charges only for the actual energy consumed by the Contractor shall be recovered by the Employer based on prevalent rate of DISCOM.

Supply, erection, testing and commissioning of all equipments as required for further distribution for meeting the construction power requirements shall be in the Contractor's scope. All necessary statutory requirements for charging construction power of Contractor's network shall be in the Contractor's scope. Construction power supply network is a temporary arrangement which shall be used during the project construction phase. To meet this requirement, the equipments may be arranged by Contractor either by shifting their existing equipments at other installation or by fresh procurement, which may be taken back after commissioning of the project.

Even though the Employer shall make all efforts to maintain a continuous supply of construction power, the same is not guaranteed and Employer shall not be responsible for any loss or delays which the contractor may suffer on this account. Also the Employer shall not entertain any claim for exemption/reduction of liquidated damages for delay in execution of the contract due to irregular power supply. Contractor shall arrange/provide necessary backup arrangement on his own for uninterrupted power supply.

The Contractor shall maintain a minimum drawl power factor as per DISCOM regulations for their substations, and all such devices for maintaining power factor

shall be under the scope of contractor. All temporary wiring must comply with local regulations and will be subject to Employer's inspection and approval before connection to supply. Power supply shall not be provided for use in labor and staff colony.

1.13.00 **TYPE TEST**

Contractor shall carry out all type tests on electrical equipment's as stipulated in relevant chapters of Part-B of technical specifications.

1.14.00 **MANDATORY SPARES**

Contractors scope shall include Mandatory Spares of all equipment as mentioned in the relevant portion of Technical Specification.

Annexure-A

STANDARD FORMAT FOR ELECTRICALFEEDER LOAD LIST

1	2	3	4	5	6	7	8	9	10	11	12
S. No.	KKS code as in vendor drawing	Description of feeder	Rating (KW/A)	Supply type	Unitised /Station	Normal / Emergency	Feeder type	Running Mode	Recommended cable size	Location Coordinates	Remarks
GUIDE LINES TO FILL THE FORMAT											
Column No.	Legend	Designation	Description								
1	S. No.	1,2,3	Serial Number								
2	KKS code as in vendor drawing	- - -	Unique kks of the Equipment								
3	Description	- - -	Description of the bidders Equipment								
4	Rating		Name plate Rating in kW or Amps at 50 deg C								
5	Supply type	11 KV 3 ph AC / 3.3 KV 3 Ph AC / 415 V 3 Ph AC / 220 V DC / 240 V AC UPS / 240 V AC Non -UPS									
6	Unitised/Station	U	Unit(U) is applied for each unit.								
		S	STN(S) is applied for common equipment load.								
7	Normal / Emergency	N	Normal Supply								
		E	Emergency Supply(Emergency supply i.e DG supply)								
8	Feeder type	U	Unidirectional Motor feeder								
		B	Bidirectional Motor feeder								
		H	Heater feeder								
		S	SFU(switch fuse feeder)								
9	Running Mode	W	Working								
		S	Standby								
10	Recommended cable size	- /- / - /- /-	Recommended Incoming power cable size in: No of runs/no. of cores/ Size in mm2/Al or Cu/ PVC or XLPE								
11	Location		Location of the Equipment in coordinates row & columns as per layout								
12	Remarks		Any other relevant information								
Notes:	1) Electrical Load list shall be submitted as "MS Excel" sheet also in addition to that in pdf as per the format given above.										
	2) Each Row shall contain data of Only One equipment / load. i.e., if there are two numbers of the same equipment, they shall be indicated in two different rows with unique description & tag number.										

SUB-SECTION-III-C

CONTROL AND INSTRUMENTATION SYSTEM

CONTROL AND INSTRUMENTATION SYSTEM

1.00.00 GENERAL

a) The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives and auxiliaries in FGD system including Limestone grinding & handling system, Gypsum Dewatering & handling system, Zero liquid discharge system (ZLD) (if provided) and other systems being provided under the contract, in all regimes of operation in safe and most efficient manner. The Contractor shall provide all systems, equipment, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer.

b) The Contractor shall 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 FGD based 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.

c) The Contractor shall also provide all the instruments along with cables, JB etc. for equipments / drives and services which may not be specifically stated in this specifications but are required for completeness of the FGD Control system shall be furnished by the Contractor and for meeting the intent and requirements of these specifications.

d) The Bidder scope shall include design, manufacture, engineering, inspection & testing at supplier's works, packing, forwarding to site, unloading, erection, testing & commissioning. The following clauses describe the brief scope of supplies. Scope shall be as described briefly in the following clauses but not limited to it. The detailed technical specifications are stipulated under Part - B, Section-VI of the specification as well as in various other Parts of the Technical Specifications.

2.00.00 MEASURING INSTRUMENTS

The following shall be provided as a minimum, meeting specification requirements of Sub-section - MEAS INST of Part-B, Section-VI of Technical Specification.

2.01.00 Primary instruments like Microprocessor based transmitters employing HART protocol, thermocouples & RTDs along with temperature transmitters, pressure/diff. pressure/temperature/flow (Ultrasonic/electromagnetic) transmitter & gauges, flow sensing elements (orifice plates, flow nozzles etc), Ultrasonic, Radar type level transmitters, density meter (Coriolis type. In case the bidder proposes other type of density meter as per the bidder standard and proven practice, the same shall also be acceptable except Nucleonic

type density meter), pH analyser, SO2 analyser, Flue Gas flow transmitter, vibration transmitter, Analyzer for ZLD system etc. for:

(a) FGD plant and other system being provided under the contract, as indicated in enclosed tender diagrams (Part E) of this specification.

(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 equipments of FGD system, 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 etc., triple sensing devices shall be provided. However, for vibration measurements and protection minimum 2 number (X and Y direction) sensors per bearing 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 production, 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. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings.

2.02.00 Single Input DIN rail mounting type temp transmitters (mounted in JBs) shall be provided by the Contractor for all temperature elements under Contractor's scope.

2.03.00 CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)

2.03.01 CEMS comprising of analysers and associated items for measurement of SOx, NOx, CO, CO2, Mercury, Particulate Emission (dust density/ stack opacity) monitor, Stack Flue Gas Ultrasonic Flow Meter shall be provided for each unit by the Contractor for stack emission monitoring.

A) LIST OF FLUE GAS EMISSION ANALYSERS

S. No.	KKS CODE	DESCRIPTION	RANGE	ZONE	REMARK
1	HNE10CQ005	SOx ANALYSER	0-300/0-1000PPM (SELECTABLE)	CHIMNEY	

2	HNE10CQ001	NOx ANALYSER AT CHIMNEY	0-300/0-1000PPM (SELECTABLE)	CHIMNEY	
3	HNE10CQ002	CO2 ANALYSER	0-40%	CHIMNEY	
4	HNE10CQ004	CO ANALYSER	0-1000 (SELECTABLE IN 0-100/0-200,0-500,0-999 PPM)	CHIMNEY	
5	HNE10CQ003	OPACITY ANALYSER AT CHIMNEY	0-999 mg/m3 (PROGRAMMABLE)	CHIMNEY	
6	HNE10CQ006	Mercury (Hg) Analyser	0-100 microgram/Nm3	CHIMNEY	
7	HNE10CQ007	Flowmeter (Ultrasonic Time of Transit Type	-	CHIMNEY	

Notes:- 1) SOx, NOx, CO2 and CO analyser are shown separately for the purpose of input only, otherwise SOX, NOX, CO2 and CO analyser may be supplied as a single unit/ Combined Unit (s) meeting specification requirement.

2) These are per unit quantities.

2.03.02 CEMS, instruments shall be provided with provision for bidirectional connectivity over Modbus/RS-232/RS-485 with Employer's central cloud server for real time data monitoring, remote diagnostics & remote calibration checks, etc., complying with CPCB IT Division document "Protocol for real time (Emission & Effluent) data management from industries version 1.2 (10.6.2015) or the latest regulatory requirement prevailing at the time of award of the contract. All necessary hardware and software required at instrument end shall be provided by the Contractor. Necessary details like scheme, register addresses of analyzer, etc. shall also be provided by the Contractor for implementation of above. The Contractor shall fully assist NTPC's agency involved in implementation of above connectivity.

For CEMS - In addition to above requirement, 4-20 mA connectivity to DDCMIS shall be provided by the Contractor

2.03.03 Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for CEMS.

2.04.00 SERVICES DURING DEFECT LIABILITY PERIOD FOR CEMS

2.04.01 The Contractor shall provide an unlimited warranty on all equipments during the Defect liability period. This warranty shall include repair, replacement, replenishment of consumables (for e.g. reagents, calibration gases etc. as applicable) and correction of identified discrepancies including Analysers, Sample Handling System, Transmitters, (as applicable) etc. at no cost to Employer.

2.04.02 The Contractor shall provide warranty spares including components for each system based on (and keeping adequate over margin) normally experienced failure rate. Exhaustive list of

	all such items shall be submitted along with Datasheet for Employer's review and approval during details Engg stage regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Contractor along with the main equipment consignment. However for items which have a limited shelf life shall be dispatched in a phased manner during the warranty period. Unused spares/consumables shall be Contractor's property after expiry of warranty period and shall be taken back.
2.05.00	SERVICES DURING ANNUAL MAINTENANCE CONTRACT (AMC) PERIOD FOR CEMS
2.05.01	The Contractor shall provide complete maintenance services for each System under comprehensive Annual Maintenance Contract (AMC) for period of three years after the Warranty period.
2.05.02	The AMC shall cover total maintenance of all Analysers, Sample Handling System ,Transmitters etc. coming under the scope of each system and shall include free repair/replacement of each items, replenishment of consumables, correction of problems (if any) and supply of expendable items.
2.05.03	Further, Contractor may note that during the AMC he will be allowed to use Employer's mandatory spares, but has to replenish the same within three months' time or before completion of AMC period whichever is earlier.
2.05.04	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.
2.05.05	Contractor shall also provide a list of all required AMC spares which shall be finalized along with datasheet during detail Engineering stage. These spares will be dispatched by the Contractor at the beginning of AMC on yearly requirement basis. However for items which have a limited shelf life shall be dispatched in a phased manner during the AMC period. Unused spare/consumable shall be Contractor's property after expiry of AMC period and shall be taken back.
2.06.00	DEPUTATION OF ENGINEER/ TECHNICAL EXPERT FOR CEMS
2.06.01	Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month. Employer will intimate the contractor two weeks advance notice for start of deputation period.
2.06.02	After expiry of above six month period, Technical expert for each system shall visit site on monthly basis for monitoring the performance and rectify the problem (if any) for each system for the remaining warranty period and during entire AMC period. In the event of any malfunction/fault/failure in the system or any component thereof contractor shall depute Technical expert of respective system to reach site within 48hrs of call raised by site during the remaining warranty period and entire AMC period.

3.00.00 **PROCESS CONNECTION & PIPING**

Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated under Sub-section PCP, Part-B, Section-VI of Technical Specification.

4.00.00 **INSTRUMENTATION CABLES, C & I SYSTEM, POWER SUPPLY DISTRIBUTION CABLES & CABLE SUB-TRAYS**

a) All instrumentation cables (twisted & shielded, FRLS PVC insulated and sheathed), data highway / fibre optical cables including prefabricated cables (with plug-in connectors), cables as applicable for direct interconnection of two equipment/ system/ devices in Contractor's scope as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR etc. (even if they are not in Contractor's Scope.) shall be provided by Contractor on as required basis.

b) All power supply distribution cables required for directly connecting two equipment / systems devices in contractor's scope shall be provided by the contractor. All these cables shall be FRLS & as per IS-1554 Part – I latest edition.

c) Above cables shall be provided 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.

d) Cables required for interfacing PLC control system with Employers DDCMIS (both SG and BOP) located in CER shall be in bidder's scope.

e) Cables for connectivity of CEMS signals to Employer's Unit DDCMIS located in unit CER shall be in bidder's scope.

f) Junction boxes and power distribution boards for C&I Systems with requisite terminals shall be provided on as required basis.

5.00.00 **CONTROL VALVES & ACTUATORS**

5.01.00 Control valves, actuators and accessories, shall be provided on as required basis for meeting requirements specified under Sub-section CONTROL VALVE, Part-B, Section-VI of Technical Specification. Specially designed valves/trims to prevent cavitations and limit noise and control outlet velocity, shall be provided.

5.02.00 Microprocessor Based Electronic Positioner is to be provided on as required basis with all the Control valves and all control dampers being provided by the contractor.

6.00.00	**CONTROL SYSTEM**
6.01.00	Instrumentation and Control System with interlocks, protection and annunciation for FGD system and other system being provided under the contract shall be provided with Software and hardware as required to provide a complete functioning of the system. Dual processor based PLC system with PC based Operator Work Station (OWS), programmable station and A4 size color Laser printer etc. on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). The PLC configuration drawing shall be as per Tender drawing no. 0000-151-POI-A-013. Depending on the cable distance between FGD control room and FGD system such as Gypsum handling system, Limestone handling system etc, requirement of Remote Input Output (RIO) shall be finalized during detail engineering, In such cases, contractor to provide RIO on as required basis.
6.02.00	The Bidder shall provide software license for all software being used in Bidder's System. The software licenses shall be provided for the organization i.e. it should not be site-specific and shall also 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 Owner to seek a new license/renew license due to up gradation/change of hardware/machine in Bidder's System at site. All licenses shall be valid for the continuous service life of the plant.
6.03.00	For each equipment/drives/pumps where Local Operation is envisaged in addition to control system as mentioned in respective Mechanical Sections, Bidder to consider Local Push button station comprising following: a) Start Push Button b) Stop Push Button c) ON Running Lamp d) OFF Lamp e) MCC Disturbance Indicating Lamp
6.04.00	Contractor has to provide KKS codes for instrument and drives in the P&ID and other related document.
6.05.00	The minimum quantity per unit of furniture envisaged in FGD control room is as mentioned below: a) Chair-4 nos. b) Printer table- 1 no c) Computer table- 2 no. d) Key pad- 1 no. e) Locker set -1 no

6.06.00	Complete wiring / cabling from field devices to panels / MCC and vice versa including conduits / trays / fixtures etc. shall be in bidders scope.
6.07.00	Microprocessor based modular 24V DC power supply system shall be used for powering the control systems including its network devices. 24V DC power supply system for PLC based control system shall comprise of two sets, each set shall consist of 1 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 the sets. Contractor shall provide UPS of suitable capacity for the intended application meeting the requirements of Technical Specifications as per Cl. No. 9.05.00, Part B, III-C5. Contractor to note that UPS of configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements exceeds 5 KVA, Contractor to provide UPS with Configuration B in place of Configuration C as per Technical Specifications as per Cl. No 9.05.00, Part B, III-C5. Bidder shall provide power supply distribution panels/cabinets/boxes for sub distribution 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. For detailed requirements of FGD system, refer Sub-Section III-C, Part B Section VI of technical specifications.
7.00.00	**TYPE TEST REQUIREMENT** The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section-C-06 Type Test Requirements, Part-B, Section-VI of Technical Specification.
8.00.00	**TOOLS & TACKLES** 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.
9.00.00	**Interfacing with Employer's DDCMIS**
9.01.00	Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS (under Employer's scope) and FGD PLC (under Contractor's scope) like bypass damper status, inlet and outlet gates status, ID Fans status, ESPs status, Boiler Load Index (BLI), MFT etc. shall be provided on as required basis, for implementation of protections and interlocks. Contractor

	shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IOs and cables for minimum number of hardwired signal exchange per unit as follows DI – 80, DO – 80, AI – 20 and AO – 20. NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders in CER for powering RIO panel.
9.02.00	Control, operation and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD control room. In addition to above, it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR). To achieve the above the Contractor shall provide the following: 1) The FGD plant operation shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant. 2) Contractor shall provide necessary hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for transfer of signals. All required plant data shall be transferred to / from through links 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. 3) The Contractor shall provide all assistance to the BOP C&I (in Employer's scope) supplier including co-ordination and flow of required information etc. 4) Contractor shall provide complete logics for FGD and associated system such as booster fan blade pitch control, FGD bypass damper control, FGD inlet and outlet gate control etc. FGD OEM shall furnish recommendations, if any, for implementation in employer's DDCMIS for boiler control.
9.03.00	Bidder to visit site to estimate the distance between FGD control room and Employer's CCR/CER.
10.00.00	**Grounding System** Suitable electronic grounding is to be provided by the contractor for all C&I equipments/panels/desk in the scope of the contractor. The exact scheme shall be as finalized during detailed engineering. Also Refer tender drawing 0000-999-POI-019A and Sub-Section titled "Basic Design Criteria" in Part-B, of this Technical Specification.

SUB-SECTION-III-D

CIVIL WORKS

1.00.00 SCOPE OF CIVIL WORKS

1.01.01 Scope of Bidder shall include all Civil, Structural, Architectural works including underground facilities like drainage, sewerage, trenches, earthing mat/ grounding, of all the facilities associated with complete Flue gas desulfurization (FGD) system, Zero Liquid Discharge (ZLD) system & Chimney as specified elsewhere in the technical specification.

1.02.00 The work to be performed under this specification consists of providing all labour, materials, construction equipment, tools and plant, scaffolding, supplies, transportation, all incidental items not shown or specified, but reasonably implied or necessary for successful completion of the work including Bidder's supervision and in strict accordance with the drawings and specifications. The nature of work shall generally involve earthwork in excavation & deep underground excavation, extensive de-watering, shoring and strutting, sheet piling, back filling around completed structures and plinth protection, paving , disposal of surplus excavated materials, piling, concreting including reinforcement and form work, brick work, fabrication and erection of structural / miscellaneous steel works, inserts, architectural items & finishes such as plastering, painting, flooring, doors, windows & ventilators, glass and glazing, rolling shutters etc., permanently colour coated profiled steel sheeting, anchor bolts, R. C. C. trenches with covers, laying and testing of water pipes, sanitation, water supply, drainage, damp proofing, water proofing and other ancillary items.

1.03.00 The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, grounding, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, finishes, false ceiling and complete architectural works, etc.

The works covered under the scope of the bidder have to be executed in an operating ***/*** under construction power station. The bidder shall take all necessary precautions to protect the entire existing equipments, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason what so ever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. The bidder shall take all necessary safety measures to avoid any harm, injury to his workers/staff from the equipment / facilities of the power station.

1.04.00 If during the execution of works it is found that there is interference with the existing facilities / structures, the bidder shall revise his design / detailed drawings to clear the interference and shall provide all necessary measures for the safety of existing structures. In case the details shown in tender drawings are found to be different from actual details at site, bidder shall revise his design/ detailed drawings to suit the constraints at site. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for safety measures provided. If at any stage of work, any dismantling or modification or relocation of any existing facility is required to be done to complete the work in bidder's scope and which has been agreed by the Employer, the same shall be done by the bidder at no extra cost or time implication to the Employer. All such changes will be as per drawings and work plan approved by the employer.

1.05.00 Analysis, design and preparation of construction drawings for all structure/facilities under the scope of this package and getting the same approved from the owner.

1.06.00 Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.

2.00.00 CONSTRUCTION FACILITIES

The following are also in the Bidder's scope of work:

1. 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 bore wells with associated pumping or water tankers and treatment facilities to supply quality water as per standards.

2. Developing temporary staff colony and labour colony along with fencing etc. Land if required shall be arranged by the Bidder himself.

   However space required for bidder's office, storage, pre assembly and fabrication areas shall be provided by owner free of charge within the plant premises.

   The area to be allocated to the Bidder shall be discussed & finalized with the bidder after the award, keeping in view the availability of free space & similar requirement of other agencies.

3. Providing all arrangements for distribution of construction power at various locations as per his requirements from the supply point of Owner.

4. Providing all arrangements for the supply of construction water including bore-wells, water tankers etc.

5. Providing temporary construction office, construction stores (open / covered), workshops, material / field testing laboratory, any other temporary buildings

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. Approach road to project site is available. Further, Owner intends to construct the roads as per the layout shown in the General Layout plan in a progressive manner. Some of these roads may not be available to the bidder for his use. Similarly the drainage network for the plant site being constructed by the owner may not be available to full extent. The bidder shall plan his work within the plant area considering the above constraints of roads and drains. Access roads to his work sites, offices, stores, preassembly / fabrication yard, etc. as required for providing approach/access for men, materials, equipment, cranes, trailor, construction/erection activities etc., what so ever are required by the bidder, shall be constructed and maintained by the bidder. Bidder shall provide permanent access to all facilities/ structures from the nearby existing roads of the owner. Roads shall be in

concrete (M-35 grade) as per IRC standards, with minimum thickness of pavement (PQC) as 250mm. Width of all such roads shall be 7.5M concrete pavement.

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 Bidder 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. **Bidder's office, store, workshop, laboratory or any other temporary buildings:**

The Bidder 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 adopt 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.

Any other type of construction if proposed by the bidder shall be subject to approval of the owner. However, such construction shall be based on proper design and shall have aesthetic look.

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 ash and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Bidder shall be responsible for enforcing the same on his sub-vendors.

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.

SUB-SECTION-IV

TERMINAL POINTS & EXCLUSIONS

1.00.00 TERMINAL POINTS

1.01.00 **FGD**

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.

1.02.00 **Flue Gas Duct**

(i) Un cleaned Flue Gas — For each unit:

i) One tapping from the common Flue Gas Duct going towards the existing Chimney (in case of twin flue chimney). No load of duct shall be transmitted on the Employers facilities.

ii) One tapping each from the two Flue Gas Duct going towards the existing Chimney (in case of single flue chimney). No load of duct shall be transmitted on the Employers facilities.

1.03.00 **Auxiliary Steam System** (For ZLD application)

Contractor shall take a tap off suitably from the existing Aux. steam header (Pr. 16 ata, Temp-210 deg. C) available at BC bay below dearator floor.

1.04.00 **Equipment Cooling Water**

1.04.01 **Normal make up to ECW tank**

Contractor shall take a tap off suitably from the existing DM normal make up header (DM normal make up pump discharge) available along C-row at CD bay rack for meeting the makeup water requirement of ECW system. The pressure available at TP will be 4Ksc (gauge) wrt FGL (approx.).

1.04.02 **Emergency make up to ECW tank**

Contractor shall take a tap off suitably from the existing DM Emergency make up header (condensate transfer pump discharge) available along C-row at CD bay rack for meeting the emergency make up water requirement of ECW system. The pressure available at TP will be 4 Ksc (gauge) wrt FGL (approx.).

1.05.00	**Process Water** For FGD system, Contractor shall take a tap off suitably from the existing CW blow down header available near the CW pump house. The pressure available at TP will be 1.9 Ksc (gauge) wrt FGL (approx..).
1.06.00	**Gypsum Wash Water (Clarified Water)** For Gypsum washing, Contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available along C-row at CD bay rack for meeting the water requirement of Gypsum washing. The pressure available at TP will be 4Ksc (gauge) wrt FGL (approx.).
1.07.00	**Potable water** Contractor shall take a tap off suitably from the existing potable water supply header (potable water pump discharge) available along C-row at CD bay rack for meeting the potable water requirement . The pressure available at TP will be 3Ksc (gauge) wrt FGL (approx.).
1.08.00	**Waste Water** FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50°C.
1.09.00	**Limestone** i) For unloading of Limestone through WT/Track Hopper of the existing Coal Handling Plant, limestone 'Feed Point' before existing CHP's Crusher House. ii) For unloading with Road-Truck Unloading System, entry to truck unloading area.
1.10.00	**Gypsum** Outlet of Gypsum storage silo/shed
1.11.00	**FIRE DETECTION AND PROTECTION SYSTEM** **(i) Mechanical:** Separate Hydrant and spray header (within 100 metre) available in plant area for tapping required for Hydrant and spray system for FGD/ZLD facilities. Minimum pressure available for hydrant and spray system shall be 8 Kgf/cm2.

1.12.00 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 FGD Contractor.

1.13.00 **Electrical**

1.13.01 Terminal points of Contractor's electrical scope, applicable for all systems/ subsystems described in relevant clauses for SCOPE is given below:

(i) Terminals of Employers HT switchgear.

1.14.00 Control & Instrumentation

a) Employer's marshalling cabinets for hardwired signal exchange with Employer system.

b) Instrument air at one point (if required).

c) One (1) no. 240V, single phase, 50 Hz feeder per unit for meeting the unregulated AC power supply requirement for illumination, heating, ventilation, and utility outlets, etc. at bidder's Power supply distribution panel.

d) Two (2) 415 V, 3 – phase 3 wire, 50 Hz feeder for each set of the bidder's 24 V DC system.

2.00.00 EXCLUSIONS

SUB-SECTION-V

SALIENT DESIGN DATA

CLAUSE NO.	SALIENT DESIGN DATA

1.00.00 The Flue Gas Desulphurisation (FGD) System FOR KUDGI-I 3X800 MW, LARA-I 2X800 MW, GADARWARA-I 2X800 MW & DARLIPALLI-I 2X800 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

Sl. No	Item	Guarantee Point	Design Point
1	Boiler Load in MW (e)	800	VWO
2	Type of Coal	Worst coal	Worst coal
3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH
4	Coal Flow (T/hr)	584	611
5	Gas flow at the FGD inlet when firing respective coal (Nm^3/sec)*	848 (1336 m^3/s)	918 (1494 m^3/s)
6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius
7	Flue Gas Composition at FGD system inlet:		
	(i) O_2 (% v/v wet)	6.337	6.115
	(ii) CO_2 (% v/v wet)	10.868	10.501
	(iii) H_2O (% v/v wet)	10.910	3.958
	(iv) SO_2 (% v/v wet)	0.067	0.065
	(v) N_2 (% v/v wet)	71.818	69.362
	(vi) Inlet SO_2 (mg/Nm^3-wet)	1915	1858
	(vii) NO_x	< 100 MG/Nm^3 at 6% O_2	
	(viii) Dust (mg/Nm^3)	50	200
	(ix) SO_3 (ppm)	10.50	10.20

Sl. No	Item	Guarantee Point	Design Point
	(x) HCl (ppm)-wet	45	45
	(xi) HF (ppm)-wet	12	12
8	SO_2 removal Efficiency (Continuous) (%)	96.55	96.55

* The flue gas volume in Nm^3/sec shall be calculated at 101.325 kPa and 273.15 K.

2.00.00 The Flue Gas Desulphurisation (FGD) System FOR MOUDA-II 2X660 MW, TANDA-II 2X660 MW, NABINAGAR-I 3X660 MW, MEJA-I 2X660 MW & BARH-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

Sl. No	Item	Guarantee Point	Design Point
1	Boiler Load in MW (e)	660	VWO
2	Type of Coal	Worst coal	Worst coal
3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH
4	Coal Flow (T/hr)	524	557
5	Gas flow at the FGD inlet when firing respective coal (Nm^3/sec)*	691 (1077 m^3/s)	759 (1212 m^3/s)
6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius
7	Flue Gas Composition at FGD system inlet:		
	(i) O_2 (% v/v wet)	6.264	6.047
	(ii) CO_2 (% v/v wet)	9.876	9.546
	(iii) H_2O (% v/v wet)	12.824	15.774
	(iv) SO_2 (% v/v wet)	0.073	0.070
	(v) N_2 (% v/v wet)	70.964	68.563
	(vi) Inlet SO_2 (mg/Nm^3-wet)	2087	2001
	(vii) NO_x	< 100 MG/Nm^3 at 6% O_2	
	(viii) Dust (mg/Nm^3)	50	200
	(ix) SO_3 (ppm)	10.5	10.2

Sl. No	Item	Guarantee Point	Design Point
	(x) HCl (ppm)-wet	45	45
	(xi) HF (ppm)-wet	12	12
8	SO_2 removal Efficiency (Continuous) (%)	96.91	96.91

* The flue gas volume in Nm^3/sec shall be calculated at 101.325 kPa and 273.15 K.

3.00.00 The Flue Gas Desulphurisation (FGD) System for SOLAPUR-II 2X660 MW & MEJA-I 2X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

Sl. No	Item	Guarantee Point	Design Point
1	Boiler Load in MW (e)	660	VWO
2	Type of Coal	Worst coal	Worst coal
3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH
4	Coal Flow (T/hr)	526	564
5	Gas flow at the FGD inlet when firing respective coal (Nm^3/sec)*	713 (1115 m^3/s)	789 (1285 m^3/s)
6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius
7	Flue Gas Composition at FGD system inlet:		
	(i) O_2 (% v/v wet)	6.282	6.064
	(ii) CO_2 (% v/v wet)	10.491	10.139
	(iii) H_2O (% v/v wet)	12.096	15.075
	(iv) SO_2 (% v/v wet)	0.071	0.068
	(v) N_2 (% v/v wet)	71.061	68.653
	(vi) Inlet SO_2 (mg/Nm^3-wet)	2030	1944
	(vii) NO_x	< 100 MG/Nm^3 at 6% O_2	
	(viii) Dust (mg/Nm^3)	50	200
	(ix) SO_3 (ppm)	10.5	10.2

Sl. No	Item	Guarantee Point	Design Point
	(x) HCl (ppm)-wet	45	45
	(xi) HF (ppm)-wet	12	12
8	SO_2 removal Efficiency (Continuous) (%)	96.91	96.91

* The flue gas volume in Nm^3/sec shall be calculated at 101.325 kPa and 273.15 K.

4.00.00 The Flue Gas Desulphurisation (FGD) System for NABINAGAR 4X250 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

Sl. No	Item	Guarantee Point	Design Point
1	Boiler Load in MW (e)	250	VWO
2	Type of Coal	Worst coal	Worst coal
3	Ambient air condition	27° C temp. and 60% RH	45° C temp. and 60% RH
4	Coal Flow (T/hr)	210	222
5	Gas flow at the FGD inlet when firing respective coal (Nm^3/sec)*	280 (424 m^3/s)	307 (481 m^3/s)
6	Gas temperature at FGD inlet (deg.C)	135 degree Celsius	150 degree Celsius
7	Flue Gas Composition at FGD system inlet:		
	(i) O_2 (% v/v wet)	6.300	6.081
	(ii) CO_2 (% v/v wet)	9.988	9.652
	(iii) H_2O (% v/v wet)	12.320	15.303
	(iv) SO_2 (% v/v wet)	0.072	0.069
	(v) N_2 (% v/v wet)	71.320	68.895
	(vi) Inlet SO_2 (mg/Nm^3-wet)	2059	1973
	(vii) NO_x	< 100 MG/Nm^3 at 6% O_2	
	(viii) Dust (mg/Nm^3)	50	200
	(ix) SO_3 (ppm)	10.50	10.20

Sl. No	Item	Guarantee Point	Design Point
	(x) HCl (ppm)-wet	45	45
	(xi) HF (ppm)-wet	12	12
8	SO_2 removal Efficiency (Continuous) (%)	96.91	96.91

* The flue gas volume in Nm^3/sec shall be calculated at 101.325 kPa and 273.15 K.

5.00.00 Chimney

5.01.00 A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor. Clean gas from the absorber shall be taken to the Chimney through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a wet stack without reheating of the flue gas.

The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide.

SN	Item	Design Condition
1	Boiler Load in MW (e)	VWO
2	Gas flow (M^3/sec)	Design Point
3	Gas temperature at Chimney inlet (deg. C)	To be worked out considering Design Point conditions

4	Flue Gas velocity (m/s)	< 18 at Design Point

5.02.01 A wet stack study shall be performed by the Contractor for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed. A wet stack model study shall consist of the following:

(i) Condensation calculations
(ii) Minimum 1:12 scale physical flow model for liquid collector design
(iii) Computational flow model for plume downwash analysis
(iv) Physical or computational flow model for CEMS elevation flow performance

5.02.02 Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), include the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to rain out to the ground before evaporation.

6.00.00 **LIMESTONE CHARACATERSTICS**

Chemical Analysis(% by mass)			
1.	CaO	%	47-51.0*
2.	MgO	%	0.9-2.0
3.	Fe_2O_3	%	0.45-1.0
4.	Al_2O_3	%	1.19-2.1
5.	Si_2O_3	%	2.1-4.5
6.	Mn_2O_3	%	<0.12
7.	P_2O_5,	%	Traces
8.	Cl_2	%	<0.015
9.	Na_2O	%	<0.16
10.	K_2O	%	<0.01
11.	TiO_2	%	<0.02
12.	Total Sulphur	%	<0.1
13.	LOI	%	39.0-41.3
Physical properties			
1	Bond Index	kWh/t	13
2	Granule size		Medium

Note:

1. *Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO3 content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) CaCO3 content of 79%.

2. For the purpose of volumetric computations of limestone handling & storage system the bulk density of limestone shall be taken as 1400 kg/m3. However for

torque, drive & structural load requirements the density of lime stone shall be taken as 1700 kg/m3. For gypsum, the bulk density shall be taken as 900 kg/m^3 for volumetric computation and 1250 kg/m3 for torque, drive & structural load requirements.

7.00.00 AIR CONDITIONING SYSTEM

GENERAL REQUIREMENTS

1. All equipments shall be located indoor unless otherwise agreed to by the Employer. The equipment and layout shall generally be in accordance with the General Layout Plant drawings.
2. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments.
3. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance.

7.01.00 DESIGN PHILOSOPHY FOR AIR CONDITIONING

1. Design ambient conditions for all air conditioning system shall be as per **Appendix-A**
2. All equipments of Air Conditioning system shall be designed for continuous duty.
3. All air conditioned areas shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%.
4. The fresh air quantity for air-conditioned areas of FGD Control Room etc. shall be 0.45 M^3/minutes/person or 1.5 air change per hour whichever is greater. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units.
5. Lighting load shall be minimum 2 Watts/Sq. feet.
6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room the same shall be one per 3 Sq.M. In the equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum).
7. In Air conditioning system for FGD Control Room, return air shall be routed back to AHU room through plenum space.
8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from

the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.

9. Soft water make up (if required) for complete air conditioning system shall be provided by the bidder in-line with terminal point specified in technical specification.

10. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec.

11. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.

12. Requirement of Underdeck Insulation (for A/C area)

Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if

i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.

ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.

iii) Underneath the ceiling of AHU room located below the A/C area or exposed to Atmosphere.

13. AHU's shall be provided with two stage of filteration i.e. pre and fine filter. All fresh air supply shall also be filtered using pre and fine filter.

14. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity for each area.

15. For areas, where A/C load is of the order of 25-60 TR, Direct Expansion (D-X) type Condensing unit (with AHU) shall be provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 15-25TR, ductable split/packaged A/C shall be provided. Smaller areas which are away from the D-X type Condensing unit /central chilling units which may require air conditioning upto 15 TR rating shall be served with Hi-wall Split/Cassette air conditioner units as per requirement.

16. Insulation for supply and return air ducts: Supply and return ducts shall be insulated. All types of Insulation used for HVAC application shall be CFC/HCFC free.

7.02.00 REDUNDANCY OF EQUIPMENTS

7.02.01 Redundancy of various A/C system equipments shall be as follows:

a) FGD Control Room Building

i) Air Cooled condensing units Air conditioners: 2X100%

ii) AHU (with VVVFD): 2 X 100%

b) 100% standby shall be provided for area served by Cassette / Hi-wall Split /Ductable split AC/Package type air conditioners for all other control rooms covered in the scope of this package.

c) Fresh air fans shall be 1 x 100 % Capacity for each AHU room.

7.03.00 DESIGN PHILOSOPHY – Ventilation System

1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:

i)	For all evaporative cooled areas	-	8
ii)	General areas	-	20
iii)	MCC / Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated	-	30

2. However in areas producing lot of heat, temperature shall be the criteria as follows:-

a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas.

b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.

Note : Dry bulb temperature during summer = 45 Deg C.

The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected.

3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and exhaust fans for ventilation of heat generating areas combination of supply air fans with exhaust air fans shall be provided. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers. All other areas like pump house, Blower/compressor house (if any), etc shall be positively ventilated by a combination of supply air fan and exhaust air fan. Supply air fan catering for electrical areas (MCC & Switchgear rooms) shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only. For Positive ventilation CFM of exhaust air shall be 60% of CFM required for supply air. Similarly for

negatively ventilated area, CFM of supply shall be 60% of total CFM exhaust.

4. All the equipments of Ventilation system shall be designed for continuous duty.

5. The supply air ducts of evaporative type ventilation system entering into switchgear room, cable galleries etc. shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating). Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.

6. Circulating water Capacity for Air washer units shall be minimum 0.7 Cu.M/hr per 1000 Cu.M /hr of air flow. Velocity through piping shall be limited to 2.0 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and air velocity through ducts shall not exceed 12.5 m/sec.

7. For pumps, continuous motor rating (at 50^{O}C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range.

   For fans, compressors and blowers continuous motor rating (at 50^{O}C ambient) shall be atleast 10% above the maximum load demand at the design duty point.

8. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.

Appendix-A

Outside Design Ambient condition to be considered for Air Conditioning system and ventilation System for various project/station are as under.

Location	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Kudgi Stg-I (3x800)	Summer	42.0	21.6
	Monsoon	32.6	26.6
	Winter	16.2	12.4
LARA Stg-I (2x800)	Summer	44.0	25.5
	Monsoon	31.0	27.7
	Winter	12.2	6.6
Gadarwara Stg-I (2x800)	Summer	44.0	25.5
	Monsoon	31.0	27.0
	Winter	12.2	6.6
Darlipalli Stg-I (2x800)	Summer	43.0	27.0
	Monsoon	34.0	28.0
	Winter	11.0	5.0
Mouda Stg-II (2x660)	Summer	43.5	25.5
	Monsoon	38.0	27.5
	Winter	15.0	10.0
Solapur	Summer	43.5	25.5

STg-I (2x660)	Monsoon	38.0	27.5
	Winter	15.0	10.0
Tanda-II STG-II (2x660)	Summer	44.0	23.5
	Monsoon	34.0	28.5
	Winter	8.0	7.0
Nabinagar JV STG-I (2x660)	Summer	45.0	25.0
	Monsoon	34.0	28.0
	Winter	5.0	2.0
Meja JV STG-I (2x660)	Summer	44.0	23.5
	Monsoon	34.0	28.5
	Winter	8.0	7.0
Barh Stg-I (3x660)	Summer	43.0	27.5
	Monsoon	38.0	29.5
	Winter	7.0	5.8
Nabinagar JV (RLY) Stg-I (4x250)	Summer	45.0	25.0
	Monsoon	38.0	28.0
	Winter	5.0	2.0
Rihand STG-II&III (2x500)	Summer	43.9	25.6
	Monsoon	35	28.9

	Winter	8.9	7.2
Vindhyachal STG-III & IV (2x500)	Summer	43.9	25.6
	Monsoon	35.0	28.9
	Winter	8.9	7.2
Unchahar Stg-IV (1x500)	Summer	43.9	25.6
	Monsoon	35.0	28.9
	Winter	8.9	7.2
Kanti Stg-II (2x195)	Summer	42.8	27.5
	Monsoon	38.0	29.5
	Winter	7.2	5.0
Mouda Stg-1 (2X500)	Summer	43.5	25.5
	Monsoon	38.0	27.5
	Winter	15.0	10.0
Barh Stg-II (2x660)	Summer	43.0	27.5
	Monsoon	38.0	29.5
	Winter	7.0	5.8

8.00.00 Fire Detection and Protection System

8.01.00 General Design Criteria

All major equipment/ system components in the entire fire protection & detection system shall have the approval from one of the following:

a) Underwriters laboratories of USA

b) LPCB-UK

c) VDS

d) BIS (for the approval of pumps and valves as applicable)

e) FM- USA

However design and installation of complete system and requirements shall be approved by TAC accredited professional(s)-India.

8.02.00 Hydrant System

Design philosophy (minimum requirement)

i) Category of Hazard and minimum terminal pressure shall be as TAC norms.

ii) All the landings of staircases, building, and other multi-storied structures of the plant shall be provided with hydrant landing valves.

iii) Each of the landing valves and external hydrant valves associated with FGD area shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc as per TAC guidelines.

For landing valves of various buildings of FGD area, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines.

iv) The pipelines routed in RCC trenches shall be provided with coating and wrapping. Road, Rail or pipe trench crossing be through trestle/RCC hume pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification.

8.03.00 HVW & MVW Spray System

Design Philosophy (Minimum Requirements)

i) Design discharge density shall be as per the rules of TAC and/ or NFPA standards.

ii) Deluge valve along with trims like pressure gauge, water motor gong, etc. shall be UL/FM or equivalent approved / listed. The deluge valve (auto resetting type) assembly shall consist of accessories such as water motor gong, alarm test valves, drip/drain valves, strainers for these valves, hydraulic releasing system, solenoid valves, etc. Further, the design

features and make of all the projectors / spray nozzles shall be UL/FM or equivalent approved / listed.

iii) A strainer ('Y' type) be provided at upstream of deluge valve.

iv) Pressure switches be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock.

v) Wet type pipe detector network shall be provided for spray system using quartzoid bulb detectors.

vi) Each of the outdoor deluge valve and accessories shall be provided with housing.

vii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel when the system is selected in remote manual mode. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel.

8.04.00 **Fire Detection, Alarm and Control System**

Design Philosophy (Fire Alarm and Detection System)

i. The addressable type panels at FGD Control equipment rooms shall receive signal from sensors from various areas/ equipments of the respective units. This shall give audio-visual annunciations for fire in each of the risk area / equipment / status of the fire protection system as well as system operator open / short circuit status of detector or control cabling, etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system

ii. Alarms from the FGD fire alarm panel shall be repeated simultaneously in repeater panel at Fire station. Also the fire alarms of this area has to be communicated to the main plant Fire alarm control panel through potential free contacts.

iii. The addressable panel shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to prearranged points, supervise and monitor the complete fire detection & extinguishing circuits, initiate control functions like shutdown of draft fans, air-conditioning and ventilation plant/equipment, closure of Fire dampers in A/C & Ventilation system etc. Opening smoke extraction vents, switching on smoke extraction equipment emergency lighting, tripping of transformer lockout relays etc.

iv. All the circuits from the detectors to the panels and the circuits from the panels to the actuating devices (such as solenoid valves, deluge valves, push buttons etc.) shall be closed loop type and shall be supervised for open and short circuiting. The trouble signal also be annunciated in the respective panels.

v. Facilities shall be provided on the fire alarm panel for simulating fire conditions, sensitivity adjustment, isolation of detectors etc. from the panel.

9.00.00 **Compressed Air System**

DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE

1. All the equipments shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment.
2. The compressors and Air Drying plants shall operate under the following ambient conditions.
   - i. Minimum temperature : 10 deg.C
   - ii. Maximum temperature : 50 deg. C
   - iii. Design condition (temperature & Relative humidity) : 45 deg.C& 75% RH
   - iv. Height above MSL (m) : Refer Chapter "Project Information"
3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.

9.01.00 **Selection of Capacity of Air Compressor**

a) **Air Compressor**

Air Compressor shall be designed to meet the Instrument air and service air requirement of all the equipments/plant/systems to be supplied by the Contractor for FGD Plant and ZLD plant (if applicable) as follows:-

Sl. No.	Continuous Requirement	Quantity (in NM^3/min)
1.	Instrument air requirement for FGD plant (Continuous)	**A**
2.	Instrument air requirement for ZLD plant (Continuous)	**B**
3.	Service air requirement for FGD plant	**C**
4.	Service air requirement for ZLD plant	**D**
5.	**Total Air requirement**	**= A+B+C+D**
6.	**Capacity of air compressor**	**= 2(A+B+C+D)**

Notes: While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirements of instrument air and service air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of instrument air and service air, if any shall be converted into

continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4.

1. The capacity of air drying plant shall be equal to the capacity of the individual air compressors. The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air".
2. Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm2 (g) or more as per the requirement of Contractor.
3. The discharge pressure of compressor shall be minimum 8.5 Kg/cm^2(g).
4. The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature.
5. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C.
6. Noise level shall not exceed 90 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level.
7. Parallel operation of compressors shall be possible without any undue vibration and noise.
8. The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors.
9. All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.

10.00.00	**LIMESTONE HANDLING PLANT**
10.01.00	Rated capacity of Limestone handling system from existing CHP shall be 1200 TPH upto crushed limestone storage system. Belt speed of conveyors shall not be more than 3.4 m/s.
10.02.00	All conveyors shall be designed for 110% of rated capacity. Rated capacity (corresponding to CHP capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed capacity. For purpose of guaranteed power consumption rated capacity shall be considered in either case.
10.03.00	2x100 %(one working + one standby) conveying stream shall be provided in the CHP.
10.04.00	Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50 deg C Ambient
10.05.00	Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association' or equivalent

International Standard. **Ai** value for idler shall be considered 2.8lb (min.) for the purpose of conveyor design calculation only.

10.06.00 All mechanical, Electrical, civil and structural system design shall consider:

a) Simultaneous running of both conveyors at rated capacity.

b) Starting of one stream with other stream in standstill condition.

c) Starting of one stream with other stream in operation at rated capacity.

d) Round the clock operation of Limestone Handing Plant.

e) The following aspects shall be taken care of coal / limestone:

i) The limestone delivered to power station shall be of size 250mm and below. However, occasionally 1-2% coal of 400 mm lump size may also be encountered.

ii) Due to open cast method of mining involved, the coal may contain shale and sand stone as high as 20%. Also occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with coal/ Limestone.

iv) The coal / limestone as received' shall contain varying percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its maximum value. The sizing and selection of all equipment shall take care of above.

f) For volumetric computations of limestone handling system the bulk density of limestone shall be taken as 1400 kg/m3. However for torque & drive requirements the density of lime stone shall be taken as 1700 kg/m3. For gypsum, the bulk density shall be taken as 900 kg/m3 for volumetric computation and 1250 kg/m3 for torque and drive requirements.

10.07.00 **LHP EQUIPMENT**

a) Design capacities & margins

Sl no	Equipment	Duty requirement	Design capacity as %age of duty requirement
1	Crushers	2x50% or 1x 100%	110%
2.	Vibrating feeders	2x50% or 1x 100%	110%
3.	Paddle feeders	1x 100%	150%
4	Belt feeder for crusher house	2x50% or 1x 100%	110%

10.08.00 **Drive equipment Rating**

Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors

a) For conveyors of belt conveyor systems *120% of actual power at drive motor output

		shaft at specified design capacity
	b) Crushers, monorail hoists (travel and hoisting), elevators, rack and pinion gates, all the drives in sampling units, various pumps of DS/DE systems, service water systems, cooling water system, potable water system and sump pumps, Ventilation Fans.	*110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity.

*The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train.

Gear Box Rating :

a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity}

In any case, gear box rating shall not be less than motor nameplate rating.

b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment }

@ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues

Coupling

Not less than motor nameplate rating.

10.09.00 **Hoists**

Drive	
(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings	Motor driven for both travel & lift.
(ii) Other hoists including the hoists for handling takeup pulley and takeup weight	Manual for both travel & lift.

10.10.00 **Belt Scale**

Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least (±) 0.25 percent throughout its range.

10.11.00 **Belting and Pulleys for 1200 TPH**

a) Belt ratings shall be selected in such a way that there are only three (3) ratings for Nylon/Nylon belting and maximum two (2) ratings of steel cord belting. This however excludes sealing belt (for sealing slots of tripper floor) and belting of belt feeders. (Belting shall be completely interchangeable among same rating of belt.) Minimum number of plies for belting shall be four (4). Other details of belting shall be as specified else where in the specification.

(b) For Pulley, following minimum parameters shall be followed:

(1.) Shell thickness : 20 mm (Min.)

(2.) End disc plate thickness : 30 mm(Min.)

(3.) Maximum allowable deflection of shaft at hubs : 5 Minutes

(4.) Diameter :

(i) All drive pulleys : 800 mm dia (min.)
1000 mm dia (min.) (In case of steel cord belts)

(ii) All balance pulleys : 630 dia (min)

Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP)

(a.) Belt ratings shall be selected in such a way that there are only three (3) ratings of belting. This however excludes and belting of belt feeders. Belting shall be completely interchangeable among same rating of belt.

(b) Minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification.

(c) For Pulley, following minimum parameters shall be followed:

(1.) Maximum allowable deflection of shaft at hubs : 5 Minutes

(2.) End disc plate thickness : 12 mm (min.)
Shell plate thickness : 12 mm (min.)

(3.) Diameter:

(i) All drive pulleys : 630 dia (min)

(ii) All balance pulleys : 500 dia (min)

Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.

d) Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to three (3) nos. These shall comprise of two (2) nos. drive pulleys & one (1) no. for all balance pulleys excluding tripper & SS pulleys.

10.12.00 Bulk density of limestone & gypsum shall be considered as follows:

	Limestone	Gypsum
a) For volumetric computation	-1400 kg/m^3	900 kg/m^3
b) For load/ strength	- 1700 kg/m^3	1250 kg/m^3

10.13.00 2x100 %(one working + one standby) conveying stream shall be provided in the limestone and gypsum handling system.

10.14.00 The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days. The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to generation of minimum 7 days.

Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.

Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5). These shall comprise of two (2) nos. drive pulleys and three (3) nos. for all balance pulleys. Pulleys for Belt Feeder, fixed &travelling tripper, SS pulleys & S/R pulleys are not included in the above categories

10.15.00 **Dust extraction system**

Type : Venturi scrubber type

Location : Belt feeder after crusher & Vibrating Screening

Feeder at crusher house.

10.16.00 **Service Water System**

Service water connections are to be provided in conveyor galleries & tunnels at 50 meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two (2) nos. on each floor of crusher house.

(a.) Flow at each valve : 5 cub.m/hr

(b.) Minimum discharge

Pressure at tap point : 2 kg/sq.cm

(c) No. of valves operated : 6 nos.

Simultaneously

10.17.00 **Ventilation System**

A. Mechanical Ventilation System:

i. Underground Areas: Minimum 15 supply air changes and minimum 7 exhaust air changes per hour.

ii. Other Areas Minimum 10 supply air changes per hour.

B. Pressurized Ventilation System: Minimum 15 supply air changes per hour

10.18.00 **Chutes:**

Minimum clear cross section of chute: 1000 mm X 800 mm (inside both ways)

11.00.00 LIMESTONE HANDLING PLANT AND GYPSUM HANDLING PLANT

11.01.00 The coal conveyors shall also be suitable for handling limestone unloaded at wagon tipplers/ track hopper and being conveyed to limestone crusher house at 1200 MTPH (min). Limestone conveyors before crusher house and upto storage shed shall be rated for 1200 MTPH(min.). The rated capacity of limestone reclaimer conveyors from storage shed to limestone mill bunkers shall be 150TPH. The rated capacity of all gypsum handling conveyors shall be 150TPH.

11.02.00 **Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP)**

(a.) Belt ratings shall be selected in such a way that there are only three (3) ratings of belting. This however excludes and belting of belt feeders. Belting shall be completely interchangeable among same rating of belt.

(b) Minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification.

(c) For Pulley, following minimum parameters shall be followed:

(1.) Maximum allowable deflection of shaft at hubs : 5 Minutes

(2.) End disc plate thickness : 12 mm (min.)

Shell plate thickness : 12 mm (min.)

(3.) Diameter:

(i) All drive pulleys : 630 dia (min)

(ii) All balance pulleys : 500 dia (min)

Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.

d) Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to three (3) nos. These shall comprise of two (2) nos. drive pulleys & one (1) no. for all balance pulleys excluding tripper & SS pulleys.

11.03.00 Bulk density of limestone & gypsum shall be considered as follows:

	Limestone	Gypsum
a) For volumetric computation	-1400 kg/m^3	900 kg/m^3
b) For load/ strength	- 1700 kg/m^3	1250 kg/m^3

11.04.00 2x100 %(one working + one standby) conveying stream shall be provided in the limestone and gypsum handling system.

11.05.00 The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days. The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to generation of minimum 7 days.

SUB-SECTION-VI

FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS

1.00.00 GENERAL

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)".

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. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes.

2.01.03 The Contractor shall conduct performance test and demonstrate all the guarantees covered herein. 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 It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.

2.02.00 **Test Instrumentation, Flow Measurement and their Calibration**

2.02.01 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 and submit the same to Employer prior to commencement of test. 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 prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

Tools and tackles, thermowells (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 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.

2.02.02 The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees 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.

2.02.03 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 measurement points.

(i) Sample calculation.

(j) Acceptance criteria.

(k) Any other information required for conducting the test.

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 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.

2.04.00 **Acceptance of Guarantee Test Results**

(i) For Category-I Guarantees

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 3.00.00** of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per **clause 3.00.00** of this sub-section. However, if, the demonstrated performance guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit, 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:

Reject the equipment / system / plant and recover from the Contractor the payments already made

OR

Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies.

(ii) For Category-II Guarantees

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 even after the above modifications/replacements with in 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:

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-II” Guarantees.

3.00.00 AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT

The rate of liquidated damages and acceptable shortfall limits for different guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price of the project.

KUDGI-I (3X800 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 6032/- (US Dollar Six Thousand Thirty Two Dollars only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

LARA-I (2X800 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 2494/- (US Dollar Two Thousand Four Hundred Ninety Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

GADARWARA-I (2X800 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 2845/- (US Dollar Two Thousand Eight Hundred Forty Five only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

DARLIPALLI-I (2X800 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 2258/- (US Dollar Two Thousand Two Hundred Fifty Eight only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

MOUDA-II (2X660 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 3299/- (US Dollar Three Thousand Two Hundred Ninety Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

SOLAPUR-I (2X660 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 6970/- (US Dollar Six Thousand Nine Hundred Seventy only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

TANDA-II (2X660 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 4831/- (US Dollar Four Thousand Eight Hundred Thirty One only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

NABINAGAR JV BIHAR-I (3X660 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 2484/- (US Dollar Two Thousand Four Hundred Eighty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

MEJA JV-I (2X660 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 3697/- (US Dollar Three Thousand Six Hundred Ninety Seven only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

BARH-I (3X660 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 55,537/- (US Dollar Fifty Five Thousand Five Hundred Thirty Seven only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 222,157/- (US Dollar Two Hundred Twenty Two Thousand One Hundred Fifty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 1899/- (US Dollar One Thousand Eight Hundred Ninety Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

NABINAGAR JV RLY-I (4X250 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 21,045/- (US Dollar Twenty One Thousand Forty Five only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 255,904/- (US Dollar Two Hundred Fifty Five Thousand Nine Hundred Four only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 2129/- (US Dollar Two Thousand One Hundred Twenty Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

NOTES APPLICABLE FOR EACH PROJECT:

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.

v) The LD values are applicable on per unit basis.

4.00.00 GUARANTEES PARAMETERS

4.01.00 **Guarantees Under Category-I**

The Performance Guarantees which attract Liquidated Damages (LD) are as follows:

The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI:

(i) SO2 removal Efficiency

The Contractor shall Guarantee that SO_2 removal efficiency at guarantee point (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.)

(ii) Limestone consumption of FGD system

Limestone consumption of FGD system in kg/hr under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) and SO2 removal efficiency of not less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project)

(iii) Auxiliary Power Consumption

The Contractor shall guarantee the total auxiliary power consumption for the FGD plant in normal operation at the guarantee point conditions, as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project, inline with the requirements stipulated in clause 5.00.00 of this Sub-Section.

4.02.00 **Guarantees Under Category-II**

The parameters/capabilities shall be demonstrated for various systems/ equipments shall include but not limited to the following:-

(i) Wet ball Mill capacity at rated fineness

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.

(ii) Wet ball Mill wear parts guarantee

Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation.

(iii) Wet ball Mill ball consumption

Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced.

(iv) Vacuum Belt Filter Capacity

Contractor shall demonstrate the Designed Capacity of the Vaccum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification.

(v) Gypsum Purity

The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for guarantee point condition.

(vi) Waste Water

The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be $10m^3$/hr averaged over a 24 hour period from each unit.

(vii) Performance characteristics of fans (capacity, head developed, etc.).

(viii) Margins on fans in case Booster Fan is provided by the Contractor.

Booster Fans - As specified in Part B of **Technical Specifications**

(ix) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.

(x) 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.

(xi) Mist Outlet Droplet Content

The mist eliminator outlet droplet content shall be guaranteed to be $\leq$ 20 mg/Nm3 at absorber outlet measured over a period of 24 hrs continuous operation.

Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer.

(xii) Availability of FGD Plant

The Contractor shall guarantee the maximum availability of FGD Plant for the range of coal and limestone specified inline with the requirements stipulated in clause 7.00.00 of this Sub-Section

(xiii) Air Conditioning System

A. Following shall be demonstrated at Shop

1) Capacity and static pressure of AHU fans at its rated duty point.

B. Following shall be demonstrated at Site

1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building.

2) Guaranteed room conditions during summer for all the Air conditioned areas.

3) Vibration and noise level of condensing units & centrifugal fans of AHUs.

(xiv) Ventilation System

A. Following shall be demonstrated at Shop

1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system.

2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system.

B. Following shall be demonstrated at Site

1) Vibration & Noise level of centrifugal fans & pumps of UAF units.

(xv) Compressed Air System

a) Following shall be demonstrated at shop:

i) Capacity and discharge pressure of each air compressor.

b) Following shall be demonstrated at site:

ii) Dew point of air at the outlet of air drying plants of air compressor.

iv) Pressure drop across air drying plant .

v) Vibration and noise level of air compressors, blowers of air drying plant (if applicable)

xvi) Equipment Cooling Water System

i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other 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.

xvii) Waste Water Treatment System (Applicable for Barh-I (3X660 MW) & Nabinagar (4x250 MW)

The Contractor shall guarantee the followings.

A). Wastewater treatment capacity(m^3/hr) : ≥ 30 for **Barh-I (3X660 MW)**

B). Wastewater treatment capacity(m^3/hr) : ≥ 20 for **Nabinagar (4x250 MW)**

C). Operating time : 16hr for Pre-treatment process, 24hr for Evaporation process

D). The distillate quality (Evaporator and crystallizer combined) shall be a maximum of 50 ppm TDS at 120 ^oF, while the solids produced for disposal which will pass the paint filter test.

5.00.00 AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT

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 of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following:

i. Absorber Recirculation Pump(s)/Gas Cooling Pumps

ii. Absorber Oxidation Air Blower(s)

iii. Absorber Oxidation Tank Agitator(s)

iv. Gypsum Bleed Pump

v. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project

vi. Limestone Slurry Pump

vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project

viii. Power consumption of Booster water pump (if provided) divided by the number of units in the project.

ix. Process water pump(s) divided by the number of units in the project

x. Mist Eliminator Wash Water pump(s)

xi. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xii. DM Cooling (normally working) Water pump one(1) to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system.

xiii. Auxiliary Cooling (normally working) water pump one(1) to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system.

xiv. Booster Fans

xv. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project

xvi. Power consumption of Filtrate Pump divided by the number of units in the project

xvii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xviii. Power consumption of Cloth Wash Water Pump divided by the number of units in the project

xix. Power consumption of Hydro-cyclone and Waste Water Pump divided by the number of units in the project

xx. Power consumption of all other continuous running Agitators divided by the number of units in the project

xxi. Air Conditioning System (*)

Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building and ZLD Control Room Building (if provided) divided by total nos. of units in respective project..

xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)

((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of air washer units and at an elevation of RL (+) - m for both AHUs and Air washer unit centrifugal fans.)

xxiii Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project

xxiv. Power consumption of Evaporator feed pump divided by the number of units in the project, in case ZLD system is provided

xxv. Power consumption of Evaporator/Brine concentrator recirculation pump divided by the number of units in the project, in case ZLD system is provided

xxvi. Power consumption of Distillate pump divided by the number of units in the project, in case ZLD system is provided

xxvii. Power consumption of Crystalliser feed pump divided by the number of units in the project, in case ZLD system is provided

xxviii. Power consumption of Crystalliser recirculation pump divided by the number of units in the project, in case ZLD system is provided

xxix. Power consumption of Mechanical vapour Compressor divided by the number of units in the project, in case ZLD system is provided

The equipment's 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.

Note :

1. The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval.
2. 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.

6.00.00 METHOD OF COMPUTING TEST EFFICIENCY OF FGD

The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the test shall, however be mutually agreed upon between the employer and the contractor.

7.00.00 METHOD OF COMPUTING AVAILABILITY

The Contractor shall guarantee 98 % availability of FGD plant including waste water treatment system for Zero Liquid Discharge (ZLD), wherever provided, for a continuous period of 120 days. An availability guarantee test shall be conducted to assure this level of availability for a period of 240 days as per the procedure indicated below.

Availability 'A' in %:

$$A = \frac{Tc \times 100\%}{Tk}$$

Tc – recorded time of FGD operation, expressed in hours,

Tk – recorded time of boiler operation, expressed in hours,

However, it is required that:

(i) In order to calculate the FGD availability, operation hours will be counted except boiler start-ups when the operation hours counting will start on the moment of shut down of all oil burners,

(ii) FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO2

content is below 100 mg/Nm3 (dry basis at 6% O_2) in cleaned flue gas for the range of specified coals & loads.

(iii) If FGD is out of operation during the boiler operation time as a result of the Employer's decision, this time will not be counted as boiler operation time for calculating the FGD availability,

(iv) Boiler operation hours will be counted based on the recorded boiler operation hours and the recorded data will be made available to the Contractor by the Employer.

Mandatory spares have been identified in the Employer. Contractor can use the mandatory spares supplied under the contract during this period in agreement with the Employer. However, if other additional spares are required for demonstration of availability demonstration guarantee, Bidder to should clearly indicate along with their offer.

If the calculated availability after 120 days availability test is lower than the guaranteed value, the Contractor will undertake actions as per clause 2.04.00 (ii) of this Sub-Section to achieve the guaranteed availability.

SUB-SECTION-VII

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.

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 desiccators 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.
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.

Mandatory Spares List (For Each Project)

Sl. No.	Description	Nos. / Sets for Each Project
1.01.00	**A. Booster Fans**	
	1. Fan assembly (excluding fan body)	1 no.
	2. Booster fan motor	1 no.
	3. Fan bearings	1 set
	4. Booster fan motor bearings	1 set
	5. Spares for blade bearing Assembly	
	5.1 Bearings	2 sets
	5.2 'O' rings	2 sets
	5.3 Bushes	2 sets
	5.4 Metallic rings	2 sets
	5.5 Intermediate piece (if applicable)	1 sets
	6. Lube Oil / Hydraulic Oil system	
	6.1 Pump assembly	1 nos. of each type
	6.2 Pump motor	1 no. of each type & rating
	6.3 Pressure regulator	2 nos.
	6.4 Filters	2 nos.
	6.5 Coupling between oil pump & motor	1 nos.
	7. Fan Blades	1 sets
	8. Coupling between Fan & Motor	1 sets.
	9. Hydraulic servomotor	1 no.
	10. Booster fan impeller liner	1 sets
	11. Booster fan casing liner	1 set

1.02.00	**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 & rating
	3. Expansion joint	1 number for each type and size
	4. Seals for guillotine gate(Both port side and bonnet side) (In case Gates are provided)	1 set for each gate
1.03.00	**Not Used**	
1.04.00	**Absorber**	
	1. Liner Material	5% coverage of each material and thickness for one Unit/Absorber
	2. Absorber Spray/Oxidation nozzles	10% of each type and size
	3. Absorber Mist Eliminator Washing Nozzles	10% of each type and size
	4. Absorber Mist Eliminator	5% of each type and size/configuration
1.05.00	**Oxidation Air Blower**	
	1. Impeller Assembly	1 no.
	2. Bearings	1 no. of each type
1.06.00	**(A) Agitators** (For Absorber Oxidation Tank & Aux. Absorbent/Emergency tank),	
	1. Impeller Assembly	1 no. of each type and size
	2. Bearing Assembly	1 no. of each type and size

	3. Motor	1 no. of each type and size
	4. Belt and Pulley (If applicable)	1 no. of each type and size
	5. Gear Box Assembly (If Applicable)	1 no. of each type and size
	6. Agitator shaft assembly	1 no. of each type and size
	7. Shaft seal	1 no. of each type and size
	8. Complete Agitator assembly	1 no. of each type and size
	(B) AGITATORS for Mill Separator Tank, Limestone Slurry Preparation Tank, Secondary hydroclone feed, Waste water, Filtrate 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. Agitator shaft assembly	1 no. of each type and size
	7. Complete Agitator assembly	1 no. of each type and size
1.07.00	**Slurry Pumps** (Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump, Gypsum Bleed Pumps, Mill Circuit Pump, Limestone slurry supply Pumps and any other slurry pumps)	
	1. Impeller Assembly	4 no. of each type and size
	2. Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump Bidder shall supply complete casing)	1 no. of each type and size

	3. Casing Liners (where replaceable liners are provided)	1 set*
	4. Seals	4 set of each type and size
	5. Bearings	1 no. of each type and size
	6. Motor	1 no. of each type and size
	7. GEAR BOX	1 No. for each type and size of pump.
	8. Motor-Pump Coupling	1 no. of each type
1.08.00	**Hydro-cyclones** (Mill , Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone)	
	1. Hydro-cyclone Isolation Valve	10% of each type OR 1 no. whichever is higher
	2. Hydro-Cyclone	10% of each type OR 1 no. whichever is higher
	3. Hydro-Cyclone rubber lining-Feed chamber and Overflow chamber	10% of each type OR 1 no. whichever is higher
	4. Vortex finder & Apex inserts	10% of each type OR 1 no. whichever is higher
1.09.00	**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*
	6. Feeder weighing roll	1 no.
	7. Gravimetric feeder gate actuator	1 no.

	assembly	
	8. Counter assembly of feeder complete	1 no.
	9. Feeder head pulley assembly	1 no.
1.10.00	**Limestone Mills**	
	1. Mill Wear Parts (Liners) & Grinding element	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.	
	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	1 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

1.11.00	**Slurry Valves**	4 no. of each type and size
1.12.00	**Slurry Line Bends**	4 no. of each type and size
1.13.00	**Vacuum Belt Filter**	
	1. Filter Cloth	4 sets
	2. Belt	1 sets
	3. Vacuum Box Seals	2 sets
	4. Drive Motor	1 no.
1.14.00	**Vacuum Pumps**	
	1. Pump Impeller Assembly	1 no.
	2. Pump Bearing	1 set
	3. Seals	1 set
	4. Motor	1 no.
1.15.00	**Vacuum Breaker Valves**	
	1. Valve Assembly	1 no.
	2. Actuator	1 no.
1.16.00	**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	4 no. of each type
	5. Pump discharge valve assembly	1 no. of each type
1.17.00	**Horizontal Centrifugal 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

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.

1.18.00	**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	4 nos. of each type
	7. Overcurrent relay	2 nos. of each type
	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	
	'O' rings	3 sets *
	Sealing ring of each type	3 sets *
	21. Spares for brake	
	Fan	2 nos. of each type
	Magnetic coil	3 nos. of each type
	Brake disc	2 sets *
	Brake pad	2 sets *
	22. Bushing (for door front)	2 sets *
	23. Pinion	2 nos. of each type
	24. Elevator Motor with VVVF drive	1 no of each type

1.19.00 AIR CONDITINING AND VENTIALTION SYSTEM

1.0	**Air handling unit (for each model)**	
1.1	V-belts for AHU Blower	2 Sets

1.2	AHU Blower bearing	1 Set
1.3	Blower motor bearing	1 Set
1.4	Filters at suction and discharge of all AHUs	25% of installed population
2.0	**Unitary air filtration unit**	
2.1	*Supply Air fans*	
2.1.1	V-belts for supply air fans	2 Sets
2.1.2	Supply air fan bearings	1 Set
2.2	*UAF Pump*	
2.2.1	Pump bearings	1 Set
2.2.2	Impeller for pump	1 no.
2.2.3	Pump Shaft	1 no.
2.2.4	Shaft sleeves	1 Set
2.2.5	Gland Packings for pumps	1 Set
2.2.6	Nylon Filter	1 Set
2.2.7	Spray nozzles	5% of total population or 50 Numbers whichever is higher.
2.2.8	Water strainer	1 No.
2.2.9	Brass suction screen/strainer for unitary air filtration tank.	1 Set
2.2.10	Motor for Centrifugal fan for UAF	1 No
3.0	**Control & Instrumentation**	
i)	Air-Conditioning System	

3.1	Electronic Transmitters	
3.1.1	Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.)	5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population)
3.2	Temperature elements	
3.2.1	RTD's*	5% or 1 No. which ever is more **
3.2.2	Thermo well * (With head assembly, terminal block and nipple)	5% or 1 No. which ever is more ** ** (to be divided into various insertion lengths in proportion to main population)
3.3	All types of Local Indicators	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main population of all make, model and type)
3.4	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, and	5% or 1No. of each type and

	differential temperature, level switch Devices.	model whichever is more.
3.5	Relative Humidity Sensors	1 No.
3.6	Geyserstat	1 No.
3.7	Local Humidity/Temperature indicators	2 Nos. each
4.0	**Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)**	
4.1	Valves	10% or 1 No. of each type, class, size and model whichever is more.
4.2	2 way, 3way, 5way valve manifolds	10% or 1 No. of each type, class, size and model whichever is more.
4.3	Fittings	10% or 1 No. of each type, class, size and model whichever is more.
(II)	Ventilation System	
5.0	**Measuring Instruments**	
5.1	Pressure Gauge	1 No. (for centrifugal pumps of UAF units).
5.2	Level transmitter	1 No.
5.3	Pressure transmitter	1 No. (for UAF units)

6.0	**Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)**	
6.1	Valves	1 no. of each type, class, size and model
6.2	2 way valve manifold	1 no. of each type, class, size and model
6.3	Fittings	1 no. of each type, class, size and model

1.20.00 SPARES FOR FGD WASTE WATER TREATMENT (FGD WWT) SYSTEM FOR ZLD (APPLICABLE FOR PROJECTS WHERE ZLD SYTEM IS BEING PROVIDED)

A-1) Blowers (If applicable) (FOR EACH TYPE & SIZE)			
Sl. No.	**Name of Items**	**Unit**	**QTY**
1)	Impeller with nuts & other accessories	Set	1
2)	Shaft	Set	1
3)	Bearings of Blowers	Set	1
4)	Suction filter Assembly	Set	1
5)	V Belts (if applicable)	Set	1
Note : One(1) set consists of quantity required for complete replacement for one(1) blower			
A-2) Flushing/Cleaning System (if applicable) (FOR EACH TYPE & SIZE)			
Sl. No.	**Name of Items**	**Unit**	**QTY**
1)	Flushing Pump	No	1
A-3) Chemical Cleaning System (If applicable) (FOR EACH TYPE & SIZE)			
Sl. No.	**Name of Items**	**Unit**	**QTY**
1)	Mixer (Agitator) of Chemical Tanks	No	1
2)	Chemical Cleaning Pump	No	1
3)	Cartridge Filter Elements (If applicable)	Set	1

a- 4) Spares for horizontal pumps for FGD WWT system for ZLD (for each type & size)

Sl. No.	Name of Items	Unit	QTY
1)	Impeller with nuts & other accessories	Set	1
2)	Wearing rings (Impeller & Casing ; as applicable)	Set	2
3)	Shaft	Set	1
4)	Shaft Sleeves	Set	2
5)	Pump & Drive Coupling, bushes, pins with all fasteners	Set	1
6)	Pump bearings	Set	1
7)	Mechanical Seal (if applicable)	Set	1

Note : One(1) set consists of quantity required for complete replacement for one(1) Pump of each type/size

A-5) Spares for Clarifier

Sl. No.	Name of Items	Unit	Qty
1)	Turbine drive shaft assembly (If applicable)	Set	1
2)	Rake (Scrapper) drive shaft assembly (If applicable)	Set	1
3)	Oil seal for gear box	Set	1

Note: One (1) set consists of quantity required for complete replacement for one clarifier.

A- 6) Spares for Injection/dosing pumps in Chemical storage & dosing system (for each type & size)

Sl. No.	Name of Items	Unit	QUANTITY
1)	Complete Pump	**Set**	**1**

A- 7) Spares for Unloading pumps in Chemical storage & dosing system (for each type & size)

Sl. No.	Name of Items	Unit	QTY.
1)	Complete Pump	Set	1

a-8) Spares for Agitators (for each type & size)

Name of Items	Unit	QTY
Agitator Assembly with Motor & Gear Box	Set	1

A- 9) Valves (except Control Valves)

Sl. No.	Name of Items	Unit	QTY
1)	Valves of all types	LOT	1 numbers of each type / size /material of construction/Rating

A- 10) Spares for Electrically operated hoist for FGD WWT system for ZLD (for each type & size)			
Sl. No.	**Name of Items**	**Unit**	**QTY.**
1)	Bearings	Set	1
2)	Rope guide	Set	1
3)	Brake lining	Set	1
4)	Wire rope	Set	1
Note : One(1) set consists of quantity required for complete replacement for one(1) hoist of each type & capacity			

A- 11) Spares for Plate type heat exchangers for FGD WWT system for ZLD (for each type & size)			
Sl. No.	**Name of Items**	**Unit**	**QTY.**
1)	Gaskets	Lot	comprising 30% of total requirement
2)	Fastners	Lot	comprising 10% each type
3)	Plates	Lot	comprising 20% of each type
Note : One(1) set consists of quantity required for complete replacement for one(1) heat exchanger of each type & capacity			

A- 12) Spares for Vapor Compressors for FGD WWT system for ZLD (for each type & size)			
Sl. No.	**Name of Items**	**Unit**	**QTY.**
1)	Impeller Assembly	Set	1
2)	Bearings	Set	1
Note : One(1) set consists of quantity required for complete replacement for one(1) compressor of each type & capacity			

1.21.00 **AIR CONDITINING AND VENTIALTION SYSTEM**

1.0	**Air handling unit (for each model)**	
1.1	V-belts for AHU Blower	2 Sets
1.2	AHU Blower bearing	1 Set
1.3	Blower motor bearing	1 Set
1.4	Filters at suction and discharge of all AHUs	25% of installed population

2.0	**Unitary air filtration unit**	
2.1	*Supply Air fans*	
2.1.1	V-belts for supply air fans	2 Sets
2.1.2	Supply air fan bearings	1 Set
2.2	*UAF Pump*	
2.2.1	Pump bearings	1 Set
2.2.2	Impeller for pump	1 no.
2.2.3	Pump Shaft	1 no.
2.2.4	Shaft sleeves	1 Set
2.2.5	Gland Packings for pumps	1 Set
2.2.6	Nylon Filter	1 Set
2.2.7	Spray nozzles	5% of total population or 50 Numbers whichever is higher.
2.2.8	Water strainer	1 No.
2.2.9	Brass suction screen/strainer for unitary air filtration tank.	1 Set
2.2.10	Motor for Centrifugal fan for UAF	1 No
3.0	**Control & Instrumentation**	
i)	Air-Conditioning System	
3.1	Electronic Transmitters	
3.1.1	Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.)	5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population)

3.2	Temperature elements	
3.2.1	RTD's*	5% or 1 No. which ever is more **
3.2.2	Thermo well * (With head assembly, terminal block and nipple)	5% or 1 No. which ever is more ** ** (to be divided into various insertion lengths in proportion to main population)
3.3	All types of Local Indicators	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main population of all make, model and type)
3.4	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, and temperature, and differential temperature, level switch Devices.	5% or 1No. of each type and model whichever is more.
3.5	Relative Humidity Sensors	1 No.
3.6	Geyserstat	1 No.
3.7	Local Humidity/Temperature indicators	2 Nos. each
4.0	**Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)**	
4.1	Valves	10% or 1 No. of each type, class, size and model whichever is more.
4.2	2 way, 3way, 5way valve manifolds	10% or 1 No. of each type, class, size and model whichever is more.
4.3	Fittings	10% or 1 No. of each type, class, size and model whichever is more.

(II)	Ventilation System	
5.0	**Measuring Instruments**	
5.1	Pressure Gauge	1 No. (for centrifugal pumps of UAF units).
5.2	Level transmitter	1 No.
5.3	Pressure transmitter	1 No. (for UAF units)
6.0	**Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)**	
6.1	Valves	1 no. of each type, class, size and model
6.2	2 way valve manifold	1 no. of each type, class, size and model
6.3	Fittings	1 no. of each type, class, size and model

1.22.00 FIRE DETECTION AND PROTECTION SYSTEM

	ITEM DESCRIPTION	QUANTITY
1.0	**DELUGE VALVE ASSEMBLIES**	
1.1	Complete deluge valve assembly along with internals and accessories	
1.1.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.1.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.1.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.

	ITEM DESCRIPTION	QUANTITY
1.2	Clapper assembly complete (consisting of clapper seat rubber, screws, etc.)	
1.2.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.2.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.2.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.3	Solenoid coils	
1.3.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.3.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
1.3.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.0	**VALVES (BUTTERFLY)**	
2.1	Butterfly	
2.1.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.1.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.1.2	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.2	Disc (Butterfly)	
2.2.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.2.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.2.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.

	ITEM DESCRIPTION	QUANTITY
2.3	Stem for Butterfly Valve	
2.3.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.3.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.3.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.4	**Gasket for Butterfly Valve**	
2.4.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.4.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.4.2	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.5	**Bushing/Bearing (butterfly valve)**	
2.5.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.5.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.5.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
3.0	**BASKET STRAINERS / Y-TYPE STRAINERS for HVW / MVW SPRAY SYSTEM**	
3.1	Strainer elements with o-rings and stiffeners.	
3.1.1	Y- Type strainer	
3.1.1.1	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
3.1.1.2	100 NB	10% or 1 No. of each type, class, size and model whichever is more.

	ITEM DESCRIPTION	QUANTITY
3.1.1.3	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
4.0	**MVW SPRAY SYSTEM**	
4.1	Spray Nozzles	10% or 10 No. of each type, class, size and model whichever is more.
4.2	QB Detectors	10% or 20 No. of each type, class, size and model whichever is more.
5.0	**HVW SPRAY SYSTEM**	
5.1	Spray nozzles	10% or 10 No. of each type, class, size and model whichever is more.
5.2	QB Detectors	10% or 20 No. of each type, class, size and model whichever is more.
6.0	**FIRE DETECTORS**	
6.1	Multisensor detectors (Addressable)	10% or 10 No. of each type, class, size and model whichever is more.
6.2	Indicators assembly for smoke detectors provided in false ceiling (Response indicator)	10% or 10 No. of each type, class, size and model whichever is more.
6.3	LHS cable for conveyors	10% of each type, class, size and model whichever is more.
7.0	**CONTROL AND INSTRUMENTATION**	
7.1	**MEASURING INSTRUMENTS**	
7.1.1	All types of Local indicators	1 no. of each make, model and type
7.1.2	Process Actuated Switch Devices : (All types of Pressure, diff. pressure, flow, temperature, level switch devices).	1 no. of each type and model

	ITEM DESCRIPTION	QUANTITY
7.1.3	All type of Electronic Transmitters and Ultrasonic Transmitters including sensors.	10% or 1 no. of each type and model whichever is more.
7.1.4	Limit switches for isolation valves	1 no. of each type
7.2	**PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)**	
7.2.1	Valves	1 no. of each type, class, size and model.
7.2.2	2 way, 3 way, 5 way valve manifolds	1 no. of each type, class, size and model.
7.2.3	Fittings	5% or 1 no. of each type, class, size and model whichever is more.
7.3	**CABLES**	
7.3.1	Pre fabricated cable of each type.	1 no. of each type, size and model.
7.3.2	Pre fabricated cable connector	1 no. of each type and model
7.3.3	Other cables (including core cable, short term fire proof cable, fibre optic cables etc)	5% of each type, pair/ core and size of actual installed quantity.
7.4	**FIRE ALARM PANEL & REPEATER FIRE ALARM PANEL**	
7.4.1	Fuses	100% of population
7.4.2	Indicating lamps	100% of population
7.4.3	Push Button	10 Nos. of each type and rating
7.4.4	Power supply modules	10% or 1 No. of each type & rating whichever is more
7.4.5	Control modules, loop cards modules, isolator cards	10% or 1 No. of each type, whichever is more.

	ITEM DESCRIPTION	QUANTITY
7.4.6	LCD display of each type unit of panel	1 No.
7.4.7	Cartridges for printers	2 Nos.
7.4.8	Interface unit / modules for non-addressable devices, auxiliary / output relay modules, control modules, supervisory control modules and any other electronic modules	10% or 1 No. of each type whichever is more.
7.4.9	LED's of each type	100% of population.
7.4.10	Power supervision relay	4 Nos. of each type.
7.4.11	Fire screen / alarm buzzer	1 No. of each type

1.23.00 **Compressed Air System:**

	ITEM DESCRIPTION	QUANTITY
1.0	Oil free Screw Air Compressor	
1.1	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
1.2	L. P. Stage Complete LP Stage assembly consisting of	1 Set of each type/rating

	ITEM DESCRIPTION	QUANTITY
	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.	
1.3	Motor Bearings	2 Sets
1.4	LP stage Gear and Pinion	1 Set
1.5	HP stage Gear and Pinion	1 Set
1.6	Air Intake Filter Element With Gaskets	4 Sets
1.7	Oil Filter Element With Gaskets & Seals	4 Sets
1.8	Safety Valve Springs and Gaskets for HP stage	1 Set
1.9	Safety Valve Springs and Gaskets for LP stage	1 Set
1.10	Valves (within the compressor house with actuators	2 nos of each type/ratings/ size.
1.11	Oil Pump/Motor	
1.11.1	Oil Pump and Motor complete assembly	1 Set
1.11.2	Pump impeller/rotor with shaft	1 Set
1.11.3	Set of bearings	2 Set
1.11.4	Set of Seals	2 Set
1.12	Drain / Moisture Trap	2 Set of each type/size.
1.13	Oil Cooler Gaskets & Seals	2 sets

	ITEM DESCRIPTION	QUANTITY
2.0	**AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM (As applicable)**	
2.1	Pre filter element(Ceramic candle or as applicable)	2 sets
2.2	After filter element(Ceramic candle or as applicable)	2 sets
2.3	Heater element(if applicable)	1 sets
2.4	Blower bearing(if applicable)	1 sets
2.5	Blower motor bearing(if applicable)	2 sets
2.6	Valves & Valve Actuators (pneumatic/hydraulic)	2 sets
2.7	Heater coil for temperature stabilization (for HOC type)(as applicable)	2 sets
3.3	Rotary drum type Air drying plant for Instrument Air system (As applicable)	
3.3.1	Drive assembly consisting of motor, gear boxes, drive shaft & coupling	1 set
3.4	Motor for air compressor	1 no.
3.5	**MEASURING INSTRUMENTS**	
	1 Electronic Transmitters	
	(i) Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or 1 No. of each type and model, whichever is more
	2 Temperature elements	
	(i) RTD's* of each type and length	10% or 2 Nos. of each type and length Which ever is more
	ii) Thermocouples of each type like K-type, R-type, metal etc. and length *	10% or 2 Nos. of each type and length Which ever is

	ITEM DESCRIPTION	QUANTITY
		more
	(iii) Thermowell for application like mill outlet temperature and SH/RH/Eco/ true gas temp. in furnace	10% or 2 Nos. of each type and length Which ever is more
	(iv) Temperature transmitters	10% of each type and length whichever is more
	3 Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc.,	5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make,
	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 Dew Point meters	5% or 1 No. of each type and model whichever is more
3.6	**MICROPROCESSOR BASED/PLC BASED CONTROL/ ELECTRONIC BASED CONTRAL PANEL (IF APPLICABLE)**	
1	Fully programmed controller of electronic modules of each type (as applicable)	10% or 1 no. whichever is more
2	Power supply module (if applicable)	10% or 1 no. whichever is more

NOTE:	
1.	Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.
2.	Any fraction of a item shall mean the next higher integer.

3.	Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quantity so calculated happens to be 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.

1.24.00 LIMESTONE & GYPSUM HANDLING

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
1			**Mechanical**		
A)			**Paddle Feeder**		
1			Rotor arm with Liners & Bolts	1	sets of each type
2			Liners of rotor arms	2	sets of each type
3			Gear box (including Paddle wheel,		
			Travel drive, cable reel drive)		
	i)		Complete assembly	1	set of each type
	ii		Bearings	1	set of each type
	iii)		Oil Seals	2	nos. of each size
	iv)		Input shaft with pinion	2	sets of each type
4			**Hydraulic Power Pack**		
	i)		Rotor Pump with electric motor, coupling, valves & servo motor (mounted on pump)etc.	2	set of each type and rating
	ii)		Solenoid Valves complete with coils	2	set of each type and size

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
	iii)		Filter element (1 No. Pressure Filter + 1 No. Return Filter)	10	sets of each type
	iv)		Hydraulic Hoses	4	sets
	v)		Hydraulic Motor (for Paddle wheel)	2	nos of each type
	vi)		Hydraulic Motor (for Traverse Drive)	2	nos of each type
	vii)		Traverse pump with electric motor, coupling, valves (mounted on pump) & servo motor (mounted on pump)etc.	2	sets of each type
	viii)		Dust suppression pump and motor assembly	1	nos of each type
	ix)		Spray nozzles of dust suppression system	10	nos of each type
	x)		Cooler	1	nos of each type
5			**Carriage wheel assembly**		
	i)		Bearings	2	nos. of each type & size
	ii)		Plummer Block	2	nos. of each type & size
	iii)		Oil seals	2	nos. of each type & size
	iv)		Carriage wheel with shaft (without plummer blocks)	1	sets
	v)		Traverse drive assy including electric motor, gear box, coupling etc. Or Geared Motor as applicable	1	set
	vi)		Tension roller of paddle feeder trolley	1	set
6	i)		All type of coupling (including those between electric motor and pump, between hydraulic motor and gear box and between gear box and paddle wheel & between carriage wheel and motor)	2	nos. of each type

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
	ii)		Coupling bolt with bushes / spider /inserts	2	sets of each size
	iii)		Rubber bush / spider / inserts	8	sets of each size
7	i)		Brakes (if any)	2	sets of each type & size
	ii)		Brake shoe	4	sets of each type & size
8			**Cable reel drive**		
	i)		Complete drive unit assembly including motor, gear box, coupling etc.	1	sets of each type & rating
	ii)		Chain	2	nos.
	iii)		Plummer Block and bearings for cable reel drum	1	sets
	iv)		Cable guide assembly	1	set
	vii)		Torque regulator unit	1	set
	viii)		Friction pads	2	set
	ix)		Spring stacks	2	set
	x)		Oil seals	4	sets
	xi)		Eddy current/magnetic coupling	1	set of each type & rating
	xii)		Spare Festoon hanger cum roller assembly(below CRD)	10	nos.
	xiii)		Spare energy chain links	5%	of population
B)			**IDLERS**		
1	i)		35^{o} Troughing idlers complete with base frame and mounting brackets etc.	2.5%	of population of each type
	ii)		Rolls for (i) above	1%	of population of each type
2	i)		Troughing idlers complete with base frame & mounting brackets ctc.(for belt feeder).	30%	of population of each type
	ii)		Rolls for (i) above	30%	of population of each type

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
3	i)		35^0 impact idlers complete with mounting brackets and base frame etc.	25%	of population of each type
	ii)		Rolls for (i) above	25%	of population of each type
4			35^0 troughing training idler complete with base frame and brackets etc. (if used)	10%	of population of each type
5			Transition idler complete as in (1) above	10%	of population of each type
6			Flat return idlers complete with mounting brackets etc.	2%	of population of each type
7			Flat return idlers complete with mounting brackets etc.(for belt feeders)	30%	of population of each type
8			Flat return trainer complete with mounting brackets etc.	10%	of population of each type
9			Belt cleaning spiral rubber disc return idler complete with mounting brackets etc.	20%	of population of each type
10	i)		Two roll 10^o troughing return idler assy	2%	of population of each type
	ii)		Rolls for (I) above	2%	of population of each type
11			SS idlers	25%	of population of each type
12			Any other type of idlers	10%	of population of each type
C)			**CONVEYOR GEAR BOXES**		
	i)		Input shafts with pinion	1	set of each type and rating
	ii)		Oil seals	2	sets of each type and rating
	iii)		Bearings	1	set of each type and rating
	iv)		Hold back device	2	nos. of each type and rating
	v)		Cooling fan with cover	2	nos.of each type and rating
	vi)		Complete gear box assy with hold back device	1	set of each type and rating for population upto 10 nos.

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
				2	set of each type and rating for population more than 10 nos.
D)			**CONVEYOR DRIVE AND CONVEYOR BELT**		
a)			**Gear Coupling**		
	i)		All type of drive couplings including gear Coupling	2	nos. of each type
	ii)		Bolts for gear coupling	2	sets of each size
	iii)		Seal kit for gear coupling (o-ring)	2	sets of each type
b)			**Fluid Coupling**		
	i)		Fluid Coupling complete	1	no. of each type and size
	ii)		Multi Disc assembly (for fluid coupling)	4	nos each type and size
	iii)		Resilient Drive plate assy.	1	no. of each type and size
	iv)		Bearings	1	no. of each type and size
	v)		Seal kit for fluid coupling	2	sets of each size
	vi)		Fusible plug	10	nos. of each size
	vii)		Complete actuator and engaging assembly (including motor, gear box etc.)	1	set of each type
	viii)		Oil Cooler assembly (if applicable)	1	set of each type
	ix)		Oil pump-motor set (if applicable)	1	set of each type
	x)		Oil filters	5	sets of each type
	xi)		Oil/Cooler valves (if applicable)	2	nos. of each type
c)			**Belting**		
			Conveyor Belt		
	i)		Main Conveyors	2	drum length of 250 m of each type, size and

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
					rating if total population of particular type, size and rating of conveyor is equal to or more than 2500 m
				1	drum length of 250 m of each type, size and rating if total population of particular type, size and rating of conveyor is less than 2500 m
	ii)		Belt feeder & bunker seal belt, as applicable	one	complete length of each type
d)			**Brakes**		
	i)		Brakes	1	no of each size & type
	ii)		Brake shoes	2	sets of each size
E)			**PULLEYS**		
	i)		Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging)	1	no. of each type and size in pulley drum and shaft dia.(for population upto 10 Nos)
				2	no. of each type and size in pulley drum and shaft dia.(for population more than 10 Nos)
	ii)		Plummer Block complete with bearings & sleeves	2	no. each type and size

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
	iii)		SS Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging)	1	no. of each type and size in pulley drum and shaft dia.
F)			**BELT CLEANERS AND SKIRT BOARD**		
	i)		Modular segments for belt cleaner	5	%of total population of each type & size
	ii)		Modular segments skirt rubber for skirt board	5	%of total population of each type & size
	iiI)		Skirt Rubber	5	%of total population of each type & size
	iv)		Complete belt cleaner (internal / external)	2	%of total population of each type & size
G)			**IN-LINE MAGNETIC SEPARATORS**		
	i)		Cleated conveyor belt	1	set
	ii)		Motor, gear box drive assy. complete	1	set
	iii)		Pulleys with plummer block & bearings	1	set of each size & type
	iv)		Sheaves	1	no. of each size & type
	v)		V-belts	2	no. of each size & type
H)			**LIME SAMPLER**		
	i)		Plummer block	1	no. of each type and size
	ii)		Hammers	1	set of each type and size
	iii)		Liner plate	1	set
	iv)		Cutter lip	1	no.
	v)		Cutter seal	1	no.
	vi)		V-belts (for crusher)	1	sets
	vii)		Hammer pins	1	sets of each

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
					type and size
	viii)		Pulley	1	no. of each type and size
	ix)		Conveyor belt	1.2	times length of each type and rating
	x)		Gear box assembly for conveyor	1	no. of each type and rating
	xi)		Gear box drive assy, for primary and secondary samplers	1	set of each type and rating
	xii)		Hydraulic pump with motor and coupling	1	set of each type
	xiii)		Hydraulic motor	1	set of each type
	xiv)		Hydraulic cylinder	1	set of each type
	xv)		Cylinder sealing kit	2	set of each type
	xvi)		Set of hoses	2	set of each type
	xvii)		Coupling with grid for primary sampler	2	sets
	xviii)		Screw conveyor gear box assembly	1	set
I)			**LIME CRUSHER**		
	i)		Plummer Block assembly complete including bearing, lock nut, lock washer etc.(DE+NDE)	2	set
	ii)		Shaft seal	4	sets
	iii)		Hammer sets	10	sets or 750 Nos whichever is more (1 set means hammers required for one crusher)
	iv)		Rotor assembly complete consisting of rotor shaft & keys, End discs, Centre discs, distance rings, suspension bars, disc clamping nuts and shaft extension etc. but without hammers, bearings and pillow	1	set

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
			blocks		
	v)		Cage bars/Perforated screen plates as applicable	4	sets
	vi)		Breaker plate	4	sets
	vii)		Liners	2	sets
	viii)		Suspension bars	4	set
	ix)		Kick-off plate	4	set
	x)		Screen plate upper & lower	4	no. each
	xi)		Tramp iron pick up plate	2	no. each
	xii)		Fluid coupling		
	a)		Fluid coupling complete	1	set
	b)		Bearings	2	set
	c)		Seal kit (sealing rings)	2	sets
	d)		Fusible plugs	8	nos.
	e)		Oil pump motor set (if applicable)	1	set of each type
	f)		Oil filter	3	sets
	g)		Complete actuator and engaging assembly (including motor, gear box etc.)	1	set
	h)		Cooler assembly (if applicable)	1	no.
	i)		Oil / Water valves	2	nos. of each type
	j)		Gear Coupling/ other flexible coupling of crusher drive along with bolts and sealing kit, as applicable	2	sets
	l)		Multi Disc assembly (for fluid coupling)	2	sets. of each type and rating
	m)		Resilient Drive plate assy	2	sets. of each type and rating

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
J)			**VIBRATING (GRIZZLY/SCREENING) FEEDER**		
	i)		Bearings	2	no. of each type & size
	ii)		Seals	2	no. of each size
	iii)		Liners	1	sets.
	iv)		Screen plates	10	sets
	v)		Complete vibrating assembly consisting of all rotating parts including drive & driven unbalanced shafts including bearings, casing, spring, vibrating blocks, main shaft, sheave & unbalanced weights as applicable.	1	set of each type and rating and direction
	vi)		Hoses (if applicable)	2	set
	vii)		Drive unit assembly (including electric motor, hydraulic pump, hydraulic motor, , flexible shaft, gear box, as applicable)	1	set
	viii)		Base springs, rubber pads	2	sets. of each type & size
	ix)		V belts	4	sets. of each type & size
K)			**ELECTRIC HOISTS**		
	i)		Brake linings	2	sets of each type
	ii)		Rope guide & rope tightner	1	no. of each type
	iii)		Limit switch	2	nos. of each type & size
	iv)		Gear box/gear set	2	sets of each type
	v)		Motor/geared motor	1	no of each type & rating
	vi)		Drum bearing	1	set of each type & rating
L)			**FLAP GATES (INCLUDING THAT OF TRIPPERS)**		
	i)		Limit switch	8	nos. of each type & rating

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
	ii)		Actuator (complete with motor, gear box,limit switches etc.)	1	nos. of each type & rating
	iii)		Oil seals of Actuator	2	nos. of each type & rating
	iv)		Flap gate shaft	1	nos. of each type & rating
	v)		Pressure nut	12	nos. of each type & size
M)			**RACK & PINION GATE**		
	i)		Limit switch	2	no. of each type & size
	ii)		Rollers with bearings	2	no. of each size
	iii)		Motor gear box assembly	1	set of each type
	iv)		Actuator (complete with motor, gear box, limit switches etc.)	1	nos of each type & rating
N)			**SUMP PUMP**		
	i)		Complete pump assembly with pump, motor, coupling base etc	1	set
	ii)		Impeller with key & nut	2	set of each size & type
	iii)		Oil seal	2	nos. of each size
	iv)		Coupling bolt with bushes	2	set of each type
	v)		Pump shaft	2	no. of each size
	vi)		Shaft sleeve	2	sets of each size
	vii)		Bearing bush	2	sets of each size
	viii)		Set of bearings	2	sets
O)			**DUST SUPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER**		
	a)		Pump impeller with key & nut	1	set of each type & size
	b)		Pump Shaft	1	no of each type & size
	c)		Bearings	1	sets each type & size

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
	d)		Wearing rings	2	sets of each type & size
	e)		Shaft sleeve	2	sets of each type & size
	f)		Bushings	2	sets of each type & size
	g)		Coupling bolts & nuts (with bushes) 2 sets	1	sets each type & size
	h)		Spray nozzles	50	nos.of each type & size
	i)		Spray nozzles (for plain water dust suppression)	25	nos.of each type & size
	j)		Solenoid valves	5	% of each type and size
	k)		Globe valve / plug valves	10	% of each type and size
	l)		Gate valve	2	nos. of each size
	m)		Strainers	1	no. of each type
	n)		Compressor		
	(i)		Air filter element	8	Nos.
	(ii)		Oil filter	6	Nos.
	(iii)		Discharge Check Valve	3	Nos.
	(iv)		Oil Pump Parts (including distance ring, eccentric rings, Pump element, Pin, Key O, Ring) as applicable	2	Sets
	(v)		Inlet Valve Assembly	2	Nos.
	(vi)		Electronic regulator	3	Nos.
P)			**VENTILATION SYSTEM**		
	i)		V-Belt	1	set of each type
	ii)		Pre-filter element of pressurizing fans	2	sets of each type
	iii)		Foundation Rubber pads	1	sets of each type & size
	iv)		Bearings	1	sets of each type & size
	v)		Plummer Blocks	1	set of each type & size

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
Q)			**TRAVELLING TRIPPER**		
	I)		Complete drive assembly including gear box, coupling, brake etc.	1	set
	ii)		Complete internals of speed reducer (including input shaft, output shaft, gearset)	1	set of each size & type
	iii)		Bearings for reducer	2	sets
	iv)		Drive axle with wheels, plummer blocks, bearings etc.	1	set
	v)		Oil seals	2	nos. of each size
	vi)		Non-drive axle with wheels plummer blocks, bearings etc.	1	set of each type
	vii)		Flap gate actuator with motor, gear box, position / thrust switches	1	set of each type
	viii)		Chain assembly wiith sprockets	1	set of each type & size
	ix)		Festoon Roller assembly for flexible cable	4	Nos
	x)		Pulleys and plummer block bearings	1	no of each type
	xi)		Plummer block with bearing for cable reel drums	1	set of each type
R)			**ELEVATOR**		
	a.		**Brake**		
			1. Tool to brake	1	No.
			2. Fan	1	No.
			3. Magnet coil with housing pads	2	Nos.
			4. Brake pads	6	Nos.
			5. Adjusting sleeve	2	Nos.
			6. Fixed brake disc	2	Nos.
	b.		**Worm Gear**		
			1. Worm gear	1	no.
			2. 'O' ring	2	nos. of each

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
					type
			3. Sealing ring	2	nos. of each type
	c.		**Door Front**		
			1. Bearing	2	Nos.
			2. Roller	3	Nos.
			3. Bushing	2	Nos.
	d.		**Limit Cams**		
			1. Sensor	1	No
			2. Switch	2	Nos.
			3. Switch arm	2	Nos.
	e.		**CAD**		
			1. Guide roller	50	% of the total ones installed each type or minimum 1 no. whichever is higher
			2. Switch	1	no.
	f.		**Sliding Door**		
			1. Rollers	4	nos. of each type
	g.		**Machinery**		
			1. Guide roller	2	nos.
			2. Pinion	1	no.
			3. Rubber inserts	6	nos.
			4. Grove ring	6	nos.
			5. Brake motor	1	no.
	h.		**Cable trolley**		
			1. Ball bearing	2	nos. of each type
S)			**DUST EXTRACTION SYSTEM**		
	1		Fan Motor	1	nos. of each type & rating
	2		Plummer Blocks	2	sets of each type
	3		Bearing of fans & motor	1	set of each type

S.N.		If Applicable (Y/N)	ITEM	QUANTITY	Unit
	4		Pulley	2	nos of each type
	5		Belts	2	sets of each size
	6		Impeller and shaft of coal slury disposal pump	1	set of each type
	7		Bearing of pumps	1	set of each type
	8		Pump Motor	1	nos of each type
	9		Motor terminal blocks with studs for all motors	1	set of each rating and type of motor
	10		Spray nozzle	10	nos of each type
	11		Solenoid valve with coil	2	nos of each type
T)			**BUCKET ELEVATOR**		
	1		Buckets	10	% of total population
	2		Belt for bucket elevator	10	% of total population
	3		Linkages	20	% of total population

Note :

1. Unless stated otherwise a 'set' means items or sub-items required for each type/size range of the assembly/ sub-assembly, required for replacement in one main equipment. 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 any other reasons which result in maintaining two 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.
2. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quality so calculated happens to be a fraction, the same shall be rounded off to next higher whole number.
3. Whenever 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.
4. 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.
5. Price of each and every item is to be given separately.

1.25.00 CONTROL AND INSTRUMENTATION

1.00.00	**CONTROL AND INSTRUMENTATION**	
1.01.00	**MEASURING INSTRUMENTS**	
1.01.01	1.1 All type of Transmitters including sensors.	10% or 1 no. of each type and model whichever is more.
1.01.02	1. Temperature elements	
	1.1 RTD's* of each type and length(with head assembly, terminal block & nipple)	10% or 2 nos. of each type and length, whichever is more
	1.2 Thermocouples of each type like K-type, R-type, metal etc. * (with head assembly, terminal block & nipple)	10% or 2 nos. of each type and length which ever is more
	1.3 Cold junction compensation boxes of each model (if applicable)	10% or 2 nos. whichever is more
	1.4 Thermostatic units for each model of CJC box (if applicable)	10% or 2 nos. whichever is more
	1.5 Temperature transmitters	10% of each type and length
1.01.03	1.1 Limit switches for isolation valves	2 nos. of each type
	1.2 Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges, flow meters etc.,	5% or 1 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)
	1.3 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

1.01.04	Any other instrument (Flow transmitter, Density meter) (as applicable)	10 % or 1 no. of each type and model whichever is more
1.02.00	CEMS (SOx, NOx, CO, CO2, Mercury, Stack opacity, flue gas flow):-	
(a)	Analyzer for SOx, NOx, CO2, CO.	1 no complete instrument of each type and model.
(b)	Flue gas flow measurement	1 no. complete instrument along with sender/receiver unit
(c)	Stack Opacity measurement	1 no. complete instrument along with sender/receiver unit
(d)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating
(e)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(f)	Temp. Sensor	20% of each type and model
(g)	Heater assembly, Cooler assembly	20% of each type and model
(h)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model
(i)	Solenoids	2 nos. of each type, model and rating
(j)	Filters, light source, sensor, detector, etc.	200% of each type, model and rating
(k)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply
(l)	Heavy duty blower assembly	1 no. of each type, size and rating.
(m)	Rotameter/Air flow meter	2 nos. of each type, model and rating
1.03.00A	Analyzers (SO2, pH) for FGD system	10% or 2 Nos of each type complete with accessories

1.03.00B	Analyzers for ZLD system	
i)	PH Analyzer (a) Flow Through type cell and Electrode (b) Electronic Transmitter unity without sensor (c) Pre-fabricated cable with connector	1 no of each type 1 no of each type 1 set
ii)	Conductivity Analyzer (a) Flow Through type cell and Electrode (b) Electronic Transmitter unity without sensor (c) Pre-fabricated cable with connector	1 no of each type 1 no of each type 1 set
iii)	Turbidity Analyzer(if applicable) (a) Flow Through type cell and Electrode (b) Electronic Transmitter unity without sensor (c) Pre-fabricated cable with connector	1 no of each type 1 no of each type 1 set
iv)	Residual Chlorine Analyzer (if applicable) (a) Sensor (b) Transmitter (c) Pre-fabricated cable with connector (d) All Chemical Reagents for 12 month operation (Supply to be staggered as per the shelf life)	1 no of each type 1 no of each type 1 set 1 set
v)	Silica Analyzer (if applicable) (a) Main PCB assembly (b) Power supply Cards(if applicable) (c) Rubber Tubes & Capillary Tubes (d) Pre-fabricated cable with connector (e) Solenoid Valves (f) All Chemical Reagents for 12 month operation(Supply to be staggered as per the shelf life)	1 no of each type 1 no of each type 1 set 1 set 1 set

vi)	Any other online analyser other than those covered above (as applicable)	1 set
1.04.00	PROCESS CONNECTION PIPING (For Impulse 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 1 no. whichever is more.
	5. Filter regulators	20% of each model or 2 nos. whichever is more.
1.05.00	CABLES	
	1. Pre fabricated cable of each type.	10% of installed quantity
	2. Pre fabricated cable connector of each type	10% or 1 no. of each type and model, whichever is more.
	3. Other cables	5% of each type, pair and size of actual installed quantity
1.06.00	24V – DC POWER SUPPLY SYSTEM	
1.06.01	AC/DC isolators, contactors, timers, relays	10% of each type and rating.

1.06.02	Fuses of each type and rating	200%
1.06.03	Fuse free Circuit breakers	5% of each type and rating.
1.06.04	Electronic modules of all types	10% of each type.
1.06.05	Cooling Fans	2 nos. of each type
1.06.06	Relays of all types including overload relays	10% of each type and rating
1.07.00	**PLC CONTROL SYSTEM**	
1.07.01	Power Supply Unit	1 nos. of each type and model
1.07.02	Electronic modules(I/O modules, communication modules and any other module used in the system)	10% or 1 no. of each type and model, whichever is more.
1.07.03	Central Processor Unit	1 nos. of each type and model.
1.07.04	Interconnecting Cables	10% of each type and size
1.07.05	Cooling Fan in PLC system / cabinet	2 Nos.
1.07.06	Indication lamps of all types	100%
	1. Keyboards/mouse	
	1.1 Keyboard	2 nos. of each type.
	1.2 Mouse	2 nos. of each type.
	2. Printers and their parts	
	2.1 Color laser printer (A4)	1 no
	2.2 Long term storage unit	1 no
	2.3 Blank CDs	10 boxes
	3. HMIPIS Devices	

	3.1 OWS with licensed software loaded along with monitor	2 nos. of each type and model.
	3.2 Server for unit LAN or Information Work Stations (As applicable)	1 nos.
	3.3 Net work components like Switch /repeaters/hubs etc. (as applicable)	2 nos. of each type and model.
	3.4 Control units for LVS	1 no.
	4. Cables and Connectors.	
	4.1 Prefab interconnecting cables with connectors	2 nos. of each type and length.
	4.2 System bus cable with connectors	-do-
	4.3 I/O bus cable with connectors for remote I/O units	-do-
	4.4 Power Supply Modules & Power Packs for control system	10% of each type model and rating, whichever is more
	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.)	10% or 2 nos. of each type and model whichever is more
	6. Bus coupler/Interface hardware and other communication devices.	10% of each type and model
	7. Relays	10% of each type and rating
	8. Batteries used for battery backup of RAMs.	10% of each type and model
	9. Fuses	200 %

1.08.00	**OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS / EQUIPMENTS**	
	1. Lime Feeders	
	1.1 Motion monitor	10% or 2 nos. whichever is more.
	1.2 Speed pick-up	10% or 2 nos. whichever is more.
	1.3 Torque switch (if applicable)	10% or 2 nos. whichever is more.
	1.4 Load Cell	10% or 2 nos. whichever is more.
	1.5 Electronic cards & Power Supply cards	10% or 2 nos. whichever is more.
	1.6 Clutch (if applicable)	10% or 2 nos. whichever is more.
	1.7 Local indication lamps	200 %
	1.8 Panel meters	10% or 2 nos. whichever is more.
	1.9 Limit switch assembly for lime-on-belt, no lime flow, shear pin failure, etc.	10% or 2 nos., whichever is more.
1.09.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES (Following items shall be provided under this clause for all modulating control valves being supplied under this package)**	
	1. Pneumatic and electro-hydraulic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
	2. Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 set for each type of control valve.

	3. Diaphragms, O' rings, seals etc. of all types make etc.	100%
	4. Pressure Gauges of all types, make, rating etc.	10% or 2 nos. of each type whichever is more
	5. Solenoid valves (if applicable)	10% or 2 nos. of each type whichever is more
	6. Positioner units (complete unit)& accessories (link assembly)	10% or 1 no. of each type whichever is more
	7. Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more
	8. Air lock relays	10% or 2 nos. of each type whichever is more
1.10.00	**PNEUMATICS ISOLATION / BLOCK VALVES, ACTUATORS & ACCESSORIES (For all ON/OFF valves supplied under this package)**	
	1. Pneumatic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
	2. Diaphragms, O' rings, seals etc. of all types make etc.	100%
	3. Limit switches (complete unit)& accessories (link assembly)	10% or 2 Nos., whichever is more
	4. Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more

1.26.00 ELECTRICAL

1.01.00 LT Switchgear:

Part A:

S.No.	Item Description	Quantity
1	Complete breaker	10% of each type & rating(min 1 No)
2	Ammeter	2 Nos of each type, size & range
3	Voltmeter	2 Nos of each type, size & range
4	Relays	10 % of each type (min 2 Nos)
5	Bus bar support insulators ~~(Porcelain)~~	10 Nos.

Part B:

1	Spring charging motors	3 Nos of each type & rating
2	Aux. Contact set	6 sets of each type & rating
3	Limit switches	10 Nos of each type.
4	Arc chutes	10% of each type & rating
5	Fixed contact set	3 Nos sets of each type & rating
6	Moving contact set	3 Nos sets of each type & rating
7	Arcing contact	3 Nos sets of each type
8	Charging spring	2 Nos of each type & rating
9	Current transformer	3 Nos of each type &

		ratio
10	Closing coil	6 Nos of each type & rating
11	Trip coil	6 Nos of each type & rating
12	CT for Bimetal O/L relays	3 Nos of each type & rating
13	Voltage transformer	3 Nos of each type & ratio
14	Control supply transformer	3 Nos of each type and rating
15	(a) Power contactor	2 Nos of each type & rating
16	(b) Coil of above contactor	2 Nos of each type & rating
17	Air break switches/ MCCBs	3 Nos of each type & rating
18	DP air break switches(DC)	3 Nos of each type & rating
19	Control & selector switches	3 Nos of each type & rating
20	Control fuses & neutral links	Total 50 Nos (Fuses) & ~~5%~~ 10 Nos (Neutral links), to cover all the ratings.
21	Indicating lamps	Total 30 Nos to cover all the types & ratings
22	Vertical bus bar dropper support insulators	25 Nos.
23	Bus duct flexible connectors (both transformer and switchgear end)	1 set for thee phases of each type & size
24	(a) Primary disconnect in MCC (Bus bar end)(Male/female contact)	Total 15 Nos. proportionately divide for all ratings

25	(b) Secondary disconnect in MCC (Cable end)	Total 15 Nos. proportionately divide for all ratings
26	Push buttons	10 Nos of each type
27	Power fuses	Total 20% proportionately divide for all ratings (min 3 Nos)
28	Thermal Bimetal relays	Total 5%. proportionately divide for all ratings (min 1 No)
29	Current transducers	2 Nos of each type & rating
30	Voltage transducers	2 Nos of each type & rating
31	Busbar aluminium flat pieces	12 meters of each type & rating
32	Busbar angles/formed pieces for breaker	2 Nos. of each type
33	Terminal blocks	12 Nos of each type & rating
1.02.00 ELECTRICAL ACTUATORS		
1	Actuators	1 no of each type and rating
1.03.00 LIGHTING		
1.	LED Fixture	5 nos of each type and rating

1.04.00 MV SWITCHGEARS		
1	Breaker of each rating	10% of each type & rating (Min 1 No.)
2	Numerical relays	10% of each type (Min 2 Nos)
3	Aux. Relays/ Lock out relays/ Timers(if applicable)	10% of each type (Min 2 Nos)
4	Bus bar support insulators	12 Nos.
5	Energy meter of each type & range	1 Nos. of each type
6	Spring charging motor complete	2 Nos. of each type.
7	Current transformer of each type & ratio	3 Nos. of each type
8	Potential transformer of each type & ratio	3 Nos. of each type
9	Shunt trip coil	5 Nos. of each type & rating
10	Closing coils	5 Nos. of each type & rating
11	Moving contact assembly of each rating (One set means complete replacement for one breaker)	2 sets
12	Stationary (fixed) contact of each rating (One set means complete replacement for one breaker)	2 sets
13	Bus seal off bushings	3 nos. of each type & size
14	Limit switches	10 Nos. of each type
15	Control switches	2 Nos. of each type
16	Selector switches	2 Nos. of each type
17	Isolation switch for the control supply	2 Nos.

18	Circuit breaker auxiliary contact assembly	6 Nos. of each type & rating
19	Indicating lamps with holders	20 set
20	(a) Fuse base and holder	12 Nos.
	(b) Fuse link	12 Nos.
21	Isolating contact (fixed & moving)(one set means male & female contacts of one complete breaker)	4 sets of each rating
22	Terminal blocks	6 Nos.
23	Multiple pin plug contact assy. with cables (male & female)	6 Nos.
24	Inter-phase barrier	2 Nos. of each type
25	Vacuum Contactors with HRC fuses (if applicable)	2 Sets (One set = Three fuses)
26	Surge arresters	3 Nos. of each rating

1.05.00 MV Busduct

a	Support insulators of each type	10 Nos.
b	Three phase set of flexible terminal connectors for switchgear end of each type & rating	1 set
c	Three phase set of flexible terminal connector for transformer end of each type & rating	1 set
d	Seal off bushings of each type & rating	3 nos.

NOTE: ONE SET MEANS COMPLETE REQUIREMENT OF ONE PHASE, WHEREVER NOT SPECIFIED

1.06.00 TRANSFORMER

Sr. No.	ITEMS DESCRIPTION	Transformer (For each type/rating)
1.	HV Bushing with metal parts and gaskets	2 Nos.
2.	LV bushing with metal parts and gaskets	2 Nos.
3.	LV Neutral bushing with metal parts and gaskets	2 Nos.
4.	WTI with contacts	1 No.
5.	OTI with contacts	1 No.
6.	Pressure relief device	1 No.
7.	MOG	1 No.
8.	Buchholz relay complete	1 No.
9.	Set of gaskets (See Note 1)	1 Set
10.	Set of valves	2 Nos. of each type/size
11.	Air cell for conservator	1 No.
12.	Neutral Grounding Resistor w/o supporting structure	1 No.

Note 1: 1 set consists of gaskets required for 1 No. transformer for the following

(a) Protection and monitoring devices

(b) Cooler circuit

(c) Largest inspection cover, if applicable

(d) HV/LV turret, if applicable

NOTE:

1. Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.

2. Any fraction of a item shall mean the next higher integer.

3. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be 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.

1.27.00 **MANDATORY SPARES FOR CHIMNEY ELEVATOR**
(Qty. indicated are for one (1) No. Chimney Elevator)

A.	BRAKE ASSEMBLY		Qty.
	1.	Brake Assembly complete	1 No.
B.	GEAR ASSEMBLY		
	2.	Gear Assembly complete	1 No.
C.	DOOR FRONT		
	3.	Bearing	3 Nos.
	4.	Roller	3 Nos.
	5.	Bushing (if applicable)	2 Nos.
D.	LIMIT CAMS		
	6.	Sensor	3 Nos.
	7.	Switch arm	3 Nos.
E.	CAB		
	8.	Guide roller	100% of the total ones installed each type or min. 1 no. whichever is higher
	9.	Switch	3 Nos.
F.	SLIDING DOOR		
	10.	Rollers (if applicable)	4 Nos. each type
G.	MACHINERY		
	11.	Guide roller	2 Nos.
	12.	Pinion	2 Nos.

	13.	Rubber inserts (if applicable)	12 Nos.
	14.	Groove ring (if applicable)	6 Nos.
	15.	Brake motor	1 No.
H.	CABLE TROLLEY BEARING (if applicable)		
	16.	Bearing	3 Nos. of each type
I.	ELECTRICAL EQUIPMENTS		
	17.	Contactors	1 No. of each type
	18.	Auxiliary transformer	1 No.
	19.	Relays	1 No. of each type & rating
	20.	Switch	2 Nos. each type
	21.	Rectifier	3 Nos.
	22.	Limit switch	3 Nos. each type
	23.	Transmitter (if applicable)	1 No. if applicable
	24.	Receiver (if applicable)	1 No. if applicable
	25.	Battery charger	1 No.
	26.	Push Buttons	3 Nos. of each type
	27.	Timers	2 Nos. of each type & rating
	28.	Main drive motor with control system	1 Set