HARYANA POWER GENERATION CORPORATION LIMITED

DCRTPP YAMUNA NAGAR (2X300 MW)

PART –A

SECTION – VI

TECHNICAL SPECIFICATION

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: 32/CE/PLG/DCRTPP/FGD-251

HARYANA POWER GENERATION CORPORATION LIMITED

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

PART – A

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-I-M (MECHANICAL SYSTEM)

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-II-E (ELECTRICAL SYSTEM)

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-III-C (CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-III-C1	BASIC DESIGN CRITERIA
SUB-SECTION-III-C2	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)
SUB-SECTION-III-C3	PROCESS CONNECTION AND PIPING
SUB-SECTION-III-C4	INSTRUMENTATION CABLES
SUB-SECTION-III-C5	DDCMIS
SUB-SECTION-III-C6	TYPE TEST REQUIREMENTS
SUB-SECTION-III-C7	CONTROL VALVES, ACTUATORS & ACCESSORIES
SUB-SECTION-III-C8	ELECTRIC ACTUATOR
SUB-SECTION-III-C9	CONTROL DESK, PANEL AND FURNITURE
SUB-SECTION-III-C10	POWER SUPPLY
SUB-SECTION-III-C11	CONTAINERISED ROOM (PORTABLE CABIN)

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D	CIVIL WORKS

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- V-Q (QUALITY ASSURANCE)

(MECHANICAL)

SUB-SECTION-V-QM1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-V-QM2	LIMESTONE & GYPSUM HANDLING
SUB-SECTION-V-QM3	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-V-QM4	AIR CONDITIONING & VENTILATION
SUB-SECTION-V-QM5	COMPRESSOR AIR SYSTEM
SUB-SECTION-V-QM6	FIRE DETECTION & PROTECTION 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 SWITCHGEAR
SUB-SECTION-V-QE9	LT SWITCHGEAR
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
SUB-SECTION-V-QE15	POWER TRANSFORMER
SUB-SECTION-V-QE16	DC SYSTEM

(CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-V-QC1	DDCMIS
SUB-SECTION-V-QC2	MEASURING INSTRUMENTS (PRIMARY & SECONDARY)
SUB-SECTION-V-QC3	POWER SUPPLY SYSTEM
SUB-SECTION-V-QC4	CONTROL VALVE ACTUATORS AND ACCESSORIES
SUB-SECTION-V-QC5	ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS
SUB-SECTION-V-QC6	VIBRATION MONITORING SYSTEM

(CIVIL WORKS)

SUB-SECTION-V-QD1 CIVIL WORKS

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- VI

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

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- VII

OPERATION & MAINTENANCE PHILOSOPHY

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- VIII

MASTER DRAWING LIST

PART - C

GENERAL CONDITIONS OF CONTRACT

PART - D

ERECTION CONDITIONS OF CONTRACTS

PART - E

LIST OF TENDER DRAWINGS

PART - F

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 Flue Gas Desulphurisation (FGD) System Package with single common absorber for DCRTPP, Yamuna Nagar (2x300 MW) project 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 equipment;

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 with single common absorber for both the units.** 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 two Booster Fans for both the units, common Absorber for both the units 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 the absorber of height more than 20 M and One (1) numbers of elevator for Limestone Grinding System building.
1.03.03	Sheds for Slurry re-circulation pumps/Oxidation blowers and Buildings for Limestone Grinding System, Compressors, Gypsum dewatering system & FGD control Room.
1.03.04	ECW system with complete facilities and equipment
1.03.05	All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set, cabling, lighting etc.
1.03.06	Low Height Wet Chimney for the project
1.03.07	Associated Control & Instrumentation (C&I) equipment.
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 Flue Gas Desulphurisation 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.	No. of Sheets
1)	Scheme of Absorber system	9944-251-POM-A-001	1
2)	Scheme of Limestone Milling system	9944-251-POM-A-002	1
3)	Scheme of Gypsum De-watering system	9944-251-POM-A-003	1
4)	P&ID Diagram for ECW System of FGD	9944-251-POM-A-004	1
5)	Limestone Flow Diagram	9944-251-POM-A-005	1
6)	Gypsum Flow Diagram	9944-251-POM-A-006	1
7)	Compressed Air System	9944-251-POM-A-007	1
8)	HVW/MWN Spray System	9944-251-POM-A-008	1

(B) CONTROL & INSTRUMENTATION

Sl. No.	Drawings Title	Drawings No.	No. of Sheets
1.	Standard configuration diagram for control system	0000-999-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-POI-A-021	3
7.	Instrument Source Connection details	0000-999-POI-A-035	14
8.	Typical GA of Local Instrument Enclosure, purging scheme, DP transmitter	0000-999-POI-A-036A	2
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	9944-000-POE-J-001 Rev1

Note : All the above drawings included in Part-E 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 clarification/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 Equipment/Systems

The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for the items/ services listed below as per the stipulated criteria indicated in the respective clauses. For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder unless otherwise specified in the respective clauses.

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 equipments, auxiliaries, systems 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.

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	Flow 485 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)
(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	Flow 10200 m3/hr (min.) with Head 16 Meters of Liquid Column (min.)

Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
(c)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant or any other process application	Flow 7300 Nm3/hr Dry Basis (min.) with Head 8500 mmwc (min.) for spray tower process Or Head 3500 mmwc (min.) for bubbling type process
(d)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant	Capacity 6.3 T/hr (min.) 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	Flow 50 m3/hr (min.) with head 30 Meters of Liquid Column (min.)
(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 or in any other process application	Capacity 11.5 T/hr (min.)

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.

The provenness criteria for equipment (Slurry Recirculation Pumps) stipulated at Sl. No. 4.01.01(b) above shall also be considered acceptable provided the rating parameters (i.e., flow and head) is covered within the operating regime of the respective Slurry Recirculation Pump 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 shall be considered qualified for manufacturing such equipment, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meets 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, shall also be considered qualified for manufacturing 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 shall also be considered qualified for manufacturing 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 meets 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 shall also be considered qualified for manufacturing 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 meets 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 shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the equipment valid up to the end of defect liability period of the contract as per the format enclosed in the bidding documents, at the time of placement of order on the approved sub-vendor. **OR**
4.01.05 (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 shall also be considered qualified for manufacturing Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meets 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.
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 shall also be considered qualified for manufacturing Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meets 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 shall also be considered qualified for manufacturing 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 meets the requirements stipulated at clause 4.01.01(b) 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
	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, piling, 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 4.02.01 and 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, piling, 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** Bidder/Sub Vendor should have manufactured and supplied motor of 4MW or above rating, which should have been in successful operation in at least one (1) plant for at least two (2) years.
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) numbers of draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for one (1) second and 105kA peak under a single order and these panels should have been in successful operation for at least two (2) years. **And**
4.03.02.01	(ii) Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) numbers of Air Circuit Breakers having fault rating of at least 45kA rms BREAKING, 105kA peak MAKING and 45kA withstand for one (1) second, and their associated draw out type Air circuit breaker panels having fault rating of at least 45kA for one (1) second and 105kA peak, which should have been in successful operation for at least two (2) years.

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) numbers of draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for one (1) second and 105kA peak under a single order and these panels should have been in successful operation for at least two (2) years.
	And
4.03.02.02	(ii) Bidder/Sub-vendor should have manufactured and supplied at least seventy five (75) numbers of draw out type Air Circuit Breaker panels having fault rating of at least 45kA for one (1) second and 105kA peak, which should have been in successful operation for at least two (2) years.
	And
4.03.02.02	(iii) Bidder/Sub-vendor shall be considered qualified provided its Associate or Collaborator or Technology Provider or Licensor meets the requirement stipulated in Route 1 for sourcing of Air Circuit Breakers. The Associate or Collaborator or Technology Provider or Licensor shall provide a letter of technical support for successful performance of the Air Circuit Breakers, as per the format, given in the bidding document. This letter of technical support should be submitted at the time of placement of order on the Sub-Vendor.
	And
4.03.02.02	(iv) Bidder/ Sub Vendor should have established manufacturing facility for draw out type Air Circuit Breaker Panels and draw out type Motor Control Centre Panels in India. Further, all the panels for this project shall be manufactured and supplied from the Indian manufacturing facility. **Note:** 1. 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. 2. The provenness criteria shall be applicable for all draw out type and fixed type switchboards except Lighting DBs and Welding DBs.
4.03.03	**6.6 KV SWITCHGEARS**
4.03.03.01	Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 6.6kV or above Switchgear panels with fault rating of at least 40kA for one (1) second and 100kA peak, which should have been in successful operation for at least two (2) years.

4.03.03.02	Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 6.6kV or above 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 at least two (2) years.
4.03.04	**NUMERICAL RELAYS**
4.03.04.01	Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers 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 two (2) years.
4.03.05	**AUXILIARY OIL FILLED TRANSFORMERS**
4.03.05.01	Bidder/ Sub-Vendor should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11 KV or higher rating oil filled transformers which should have been in successful operation for at least two (2) years.
	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	**PROVENNESS CRITERIA FOR CONTROL AND INSTRUMENTATION (C&I) EQUIPMENTS / SYSTEMS** The Bidder or its proposed sub vendor(s) should meet the provenness requirements as stipulated under clause 4.04.01, 4.04.02 and 4.04.03. For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on the date of consideration for approval but not later than six months after award date of the FGD package unless otherwise specified in the respective clauses.

4.04.01	The Distributed Digital Control, Monitoring and Information System (DDCMIS) supplier of this package should be Indian Company registered in India as per Companies Act and should have engineered, supplied, and commissioned/ got commissioned BOP DDCMIS/DCS system in at least one (1) unit of rating 200MW or above in a power station.
4.04.02	The Control system offered for this package shall be same or of same series which is operating successfully for a period of not less than one (1) year in at least one (1) unit of rating 200MW or above in a power station for BOP application.
4.04.03	The other C&I systems offered for this package shall meet the following: a) UPS system offered for this package shall be same or of same series and type as that of 105 KVA or above capacity UPS which should have been in successful operation for a period of not less than one (1) year in a power station. b) 24 V DC modular charger offered for this package shall be same or of same series and type as that of 500A or above capacity 24 V DC modular charger which should have been in successful operation for a period of not less than one(1) year in any industry or telecommunication application. c) CEMS and Vibration Monitoring system offered for this package shall be same or of same series which should have been in successful operation for a period of not less than one(1) year in at least one(1) unit of rating 200MW or above in a power station.
(A)	Notes:- Control system for BOP application referred in Para 4.04.01 and 4.04.02 means following: (i) Control system for BOP shall include Modulating control for Steam Generator (SG), Modulating control for feed water / Condensate Cycle, Binary Control of the auxiliaries for Steam Generator (SG) and Binary Control of the auxiliaries for Turbine generator (TG) for coal fired units.
4.05.00	**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.

4.06.00 **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 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.

4.07.00 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.

4.08.00 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

DCRTPP, YAMUNA NAGAR (2X300MW)

1.00.00 BACKGROUND

S.No	Item	Details
1	Project Name	DCRTPP YAMUNA NAGAR
2	Project Stage/Units	Unit 1 & 2
3	No. of Units x Capacity	2 X 300 MW
4	Project set up by	HPGCL
5	Place	DCRTPP Yamunanagar , (2X300 MW) VPO Pansra, Yamuna Nagar
6	Location	183 km (approx.) from Delhi and 110 km (approx.) from Chandigarh
7	District	Yamuna Nagar
8	State	Haryana
9	Country	India
10	Postal Address	Deenbandhu Chhotu Ram Thermal Power Plant , Yamunanagar Phone: 01732-298500 Fax: 01732-298501
11	District Head Quarter	Yamuna Nagar
12	Access by road	About 1 Km from Yamuna Nagar
13	Access by Rail	2 Km from Kalanaur Railway Station
14	Access by Air	Delhi at a distance of 183km
15	Access by sea	Kandla/Mudra at approx. distance of 1200 Km
16	Latitude And Longitude of Mejia Thermal Power Station	Latitude: 300 6’ N Longitude: 700 20’ E
17	Dry Bulb	28.3 0C (1951 to 1980)
18	Minimum	-0.6 0C
19	Elevation above mean sea level	268.2 m

20	Maximum ambient temp.	44.80 C
21	Wind velocity	Basic, per ISI 47 m/s Mean speed, max. 6.7 kmph
22	Annual Rain fall	Avg. 961.4 mm Monthly maximum 457mm
23	Seismic Zone	Zone no IV as IS-1893-2002

Any other information : Further to the information given in this sub-section, Bidders are advised to visit the project site and collect data on local site conditions.

2.00.00 NOT USED

3.00.00 CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the design parameters provided in this document and using the provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

The peak ground horizontal acceleration for the project site, the acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Annexure-A.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The design acceleration spectra specified at Annexure-A shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4) is used. The acceleration spectra along with multiplying factors specified in Annexure-A includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve

For buildings, if the design base shear (VB) obtained from modal combination is less than the base shear ($\bar{V}B$) computed using the approximate fundamental period (Ta) given in IS:1893:Part 1 and using acceleration spectra with appropriate multiplying factor specified at Annexure-A, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}B$/ VB. However, no reduction is permitted if $\bar{V}B$ is less than VB.

Design/Detailing for Ductility for Structures

The design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility

ANNEXURE – A

SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various seismic parameters for the project site shall be as follows:

1)	Peak ground horizontal acceleration (MCE)	: 0.24g
2)	Multiplying factor to be applied to the horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra	
a)	for special moment resisting steel frames designed and detailed as per IS:800	: 0.06
b)	For special concentrically braced steel frames designed and detailed as per IS:800	: 0.045
c)	for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920	: 0.036
d)	for RCC chimney, RCC Natural Draft Cooling Tower	: 0.12
e)	For Liquid retaining tanks	: 0.072
f)	for Steel chimney, Absorber tower, Vessels	: 0.09
g)	for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials)	: 0.06
3)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted	: 0.12

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

The seismic parameters and horizontal seismic acceleration spectral coefficients furnished are minimum design values and the same may be revised based on geotechnical investigation details, if necessary.

ANNEXURE – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)	
(Sec)	2%	5%
0.000	1.000	1.000
0.020	1.500	1.300
0.040	2.000	1.600
0.060	2.500	1.900
0.080	3.000	2.200
0.090	3.250	2.350
0.100	3.500	2.500
0.120	3.500	2.500
0.140	3.500	2.500
0.160	3.500	2.500
0.180	3.500	2.500
0.200	3.500	2.500
0.220	3.500	2.500
0.240	3.500	2.500
0.260	3.500	2.500
0.280	3.500	2.500
0.300	3.500	2.500
0.320	3.500	2.500
0.340	3.500	2.500
0.360	3.500	2.500
0.380	3.500	2.500
0.400	3.500	2.500
0.420	3.500	2.500
0.440	3.500	2.500
0.460	3.500	2.500
0.480	3.500	2.500
0.500	3.500	2.500
0.520	3.500	2.500
0.540	3.500	2.500
0.550	3.500	2.500
0.560	3.400	2.429
0.580	3.283	2.345

ANNEXURE – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)	
(Sec)	2%	5%
0.600	3.173	2.267
0.620	3.071	2.194
0.640	2.975	2.125
0.660	2.885	2.061
0.670	2.842	2.030
0.680	2.800	2.000
0.700	2.720	1.943
0.720	2.644	1.889
0.740	2.573	1.838
0.760	2.505	1.789
0.780	2.441	1.744
0.800	2.380	1.700
0.820	2.322	1.659
0.840	2.267	1.619
0.860	2.214	1.581
0.880	2.164	1.545
0.900	2.116	1.511
0.920	2.070	1.478
0.940	2.026	1.447
0.960	1.983	1.417
0.980	1.943	1.388
1.000	1.904	1.360
1.020	1.867	1.333
1.040	1.831	1.308
1.060	1.796	1.283
1.080	1.763	1.259
1.100	1.731	1.236
1.120	1.700	1.214
1.140	1.670	1.193
1.160	1.641	1.172
1.180	1.614	1.153
1.200	1.587	1.133

ANNEXURE – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)	
(Sec)	2%	5%
1.220	1.561	1.115
1.240	1.535	1.097
1.260	1.511	1.079
1.280	1.488	1.063
1.300	1.465	1.046
1.320	1.442	1.030
1.340	1.421	1.015
1.360	1.400	1.000
1.380	1.380	0.986
1.400	1.360	0.971
1.420	1.341	0.958
1.440	1.322	0.944
1.460	1.304	0.932
1.480	1.286	0.919
1.500	1.269	0.907
1.520	1.253	0.895
1.540	1.236	0.883
1.560	1.221	0.872
1.580	1.205	0.861
1.600	1.190	0.850
1.620	1.175	0.840
1.640	1.161	0.829
1.660	1.147	0.819
1.680	1.133	0.810
1.700	1.120	0.800
1.720	1.107	0.791
1.740	1.094	0.782
1.760	1.082	0.773
1.780	1.070	0.764
1.800	1.058	0.756
1.820	1.046	0.747
1.840	1.035	0.739

ANNEXURE – A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)	
(Sec)	2%	5%
1.860	1.024	0.731
1.880	1.013	0.723
1.900	1.002	0.716
1.920	0.992	0.708
1.940	0.981	0.701
1.960	0.971	0.694
1.980	0.962	0.687
2.000	0.952	0.680
2.020	0.943	0.673
2.040	0.933	0.667
2.060	0.924	0.660
2.080	0.915	0.654
2.100	0.907	0.648
2.150	0.886	0.633
2.200	0.865	0.618
2.250	0.846	0.604
2.300	0.828	0.591
2.350	0.810	0.579
2.400	0.793	0.567
2.450	0.777	0.555
2.500	0.762	0.544
2.550	0.747	0.533
2.600	0.732	0.523
2.650	0.718	0.513
2.700	0.705	0.504
2.750	0.692	0.495
2.800	0.680	0.486
2.850	0.668	0.477
2.900	0.657	0.469
2.950	0.645	0.461
3.000	0.635	0.453

4.00.00 CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Welded steel structures	: 1.0%
b) Bolted steel structures/RCC structures	: 2.0%
c) Prestressed concrete structures	: 1.6%
d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.

ANNEXURE-B

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed "V_b" at ten metres above the mean ground level : 47 metres/second

b) The risk coefficient "K_1" : 1.08

c) Category of terrain : Category-2

5.00.00	**NOT USED**
6.00.00	**NOT USED**
7.00.0	**FOUNDATION SYSTEM AND GEOTECHNICAL DATA**
7.00.00	Geotechnical data and foundation system for the FGD package at Yamuna Nagar site project are enclosed at annexure-I. The corresponding bore logs of vicinity are enclosed at annexure-II.
7.00.01	Available geotech data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed geotech investigation for facilities under this package and shall be as per the scheme approved by owner**.** The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.06.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation. Based upon the available soil data, soil up to a depth of 5m to 7m (below existing ground level) is prone to liquefaction hazard. For heavily loaded structures (Silos, Chimney, Crusher house, absorber and other structures), pile foundations may be considered and for lightly loaded structures, suitable ground improvement as per clause 7.02.04 may be considered. Minimum cut off level of pile below FGL is 3m.
7.00.02	The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable.
7.00.03	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.

7.01.00 **Not Used**

7.02.00 **Foundation System**

The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.

7.02.01 General Requirements

a) All structures/equipment shall be supported either on suitable open foundations with ground improvement (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc.

b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil.

c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil.

d) No foundation shall rest on the black cotton soil.

e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.

f) For underground facilities survey, Ground Penetration Radar (GPR) may be used.

g) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations.

h) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.

i) The water table for design purpose shall be considered at Finished Ground Level.

j) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building.

k) Foundation for miscellaneous equipment's on ground floor.

For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.

For equipment's of static weight between 1.5 T and 20 T, the equipment may be supported on compacted sand filling with the load intensity below the equipment limited to 4T/m2. The minimum depth of foundation is 1.0m below FFL. Other requirements of sand compaction below the foundation shall be adhered, as specified elsewhere in the specifications.

For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 2. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.

7.02.02 **Open Foundations**

In case open foundations are adopted, following shall be adhered to.

a) The minimum width of foundation shall be 1.0 m.

b) Minimum depth of foundation shall be 1.0m below Ground Level.

c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.

d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.

7.02.03 Pile Foundations –

Following structures are to be placed on pile foundation:

Heavily loaded structures like Silos, Chimney, Crusher house, absorber and other structures.

(a.) In case piles are adopted, following shall be adhered to :

i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Crawler mounted Rotary Hydraulic Rigs. However, conventional tripod rig may be allowed in inaccessible areas subject to site specific conditions. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.

Based upon the geotechnical investigation report, fine to course sand intermixed with pebbles/cobbles is met from 8m to 14m depth is observed where the size of pebbles/cobbles varies from 80-150 mm. in view of this, temporary/permanent MS liner may be provided for piling.

ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in annexure-I.

iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m.

iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval.

v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval.

vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under.

Vertical	Minimum of 2 Nos. in each mode.
Lateral	
Uplift	

vii) The initial pile load test shall be conducted with test load three times the pile capacity as mentioned at Annexure-I. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).

viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.

ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under :

i) Vertical : 0.5% of the total number of piles provided.

ii) Lateral : 0.5% of the total number of piles provided.

x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer.

xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required.

xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm.

xiii) The test load on initial test piles shall be applied by means of reaction from reaction piles alone or combination of reaction piles and kentledge with concrete blocks.

xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM.

xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.

The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile.

xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions.

xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles.

xviii) Reinforcement for job piles shall be designed as following:

(a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered.

(b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.

1.01.04 **Ground Improvement below structures/facilities using stone columns:**

i) The work broadly involves installation of stone columns for mitigation of liquefaction hazard, improvement in bearing capacity of the soil and to bring down the residual settlements so that the facilities that may be constructed over the stone column area shall stand safely and perform satisfactorily throughout their lifetime.

The stone columns shall be installed using bottom/top feed Vibroflotation techniques **without water jetting** i.e. dry method (displacement method) in accordance with these specifications. Installation of stone column by rammed/driven technique **without water jetting** may also be permitted/used subject to conforming to the specification and meeting to the construction schedule.

In case of vibro replacement method, the bidder shall submit the construction methodology giving information regarding details of equipment, type and energy rating of vibratory probe, details of power output, compaction criteria etc.

In case of rammed stone column methodology, the bidder shall submit the construction methodology giving information regarding type of equipment, weight of rammer, height of fall, compaction criteria, stages of casing withdrawal etc. Use of bentonite slurry for formation of stone columns shall not be permitted. A casing pipe shall be provided by the bidder upto to full depth of stone column.

In either of the above techniques adopted, the parameters shall be so chosen to give stone column of specified diameter and load carrying capacity.

In either of the above techniques adopted, the quantity of stones shall be placed in such that the column is filled in stages of height not exceeding 1m. Each stage shall be compacted to ensure uniform consumption of stones throughout the depth.

The method of placement of stone shall be such that it is possible to measure the total consumption of stones in a column.

Stone column installation procedure submitted by the bidder shall be approved by the Engineer.

ii) All materials and workmanship shall be in accordance with this specification and IS: 15284: Part 1: 2003."Design and Construction for Ground Improvement – Guidelines, Part 1 Stone Columns".

iii) Ground improvement without piling provision after it

Dia of column (d) = 900mm

Spacing = 2.5m (Triangular pattern)
Depth of ground improvement = 7m

iv) Ground improvement with stone column shall be carried out minimum d/2 distance beyond the footprint of buildings(minimum 2 rows beyond the building footprint), where d is the depth of improvement. The ground improvement shall be carried out below the entire building/structure rather than restricting it to just below the foundations.

v) Initial load tests shall be performed at the trial site as identified by Engineer to evaluate load settlement behaviour of the stone columns. These tests shall be conducted on a single as well as on a group of three columns. Load testing procedure, equipment and interpretation shall confirm to IS 15284 (Part-I).

vi) Fill material for stone columns shall comprise of stones. The individual particles should be clean, chemically inert, hard and resistant to breakage. Well graded stones of size from 75mm down to 12mm with not more than 5% fines passing 12mm sieve shall be used. The uniformity coefficient shall be greater than 5.

vii) A sand / granular blanket of 500mm compacted thickness shall be laid over the top of exposed stone columns. The blanket shall spread over the entire area of treatment cleaned off muck, slush etc. The blanket shall be laid in layers of 250mm (maximum compacted thickness) and compacted to 85% relative density. Sand/gravel blanket of minimum of 1.0 m beyond the outer edge of the stone columns shall be ensured
For Sand/gravel blanket, the sand shall be coarse to medium sand free from shingle, salts, organic matter etc. In case of gravel, fines less than 75 microns shall not be more than 20%.

vii) Boreholes shall be drilled prior and after the installation of stone columns and frequency shall be minimum 1 borehole under each structure/facility or 2000 Sqm whichever is less. The performance of the stone column(s) shall be considered acceptable and approved by the Engineer based on the SPT 'N' values of the improved ground.

The installation of stone column is considered acceptable if it achieved SPT 'N' value more than 15 from the natural ground level upto depth of improvement. The minimum load intensity after ground improvement shall be as mentioned in table-2 in Annexure-I.

7.03.00 Special Requirements

7.03.01 Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.

7.04.00 Excavation, Filling and Dewatering

7.04.01 For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.

7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.
7.04.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils
7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.
7.05.00	**Sheeting & Shoring** The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.
7.06.00	**Geotechnical Investigation** The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.
7.06.01.00	**Scheme of geotechnical Investigation**
7.06.02.01	Field test shall include but not be limited to the following: Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.

7.06.02.02	The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.
7.06.02.03	The minimum tests are indicated in Clause No. 7.07.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.
7.06.02.04	Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers. **Laboratory Tests on Soil Samples** Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel. **Laboratory Tests on Rock Samples** Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.
7.06.02.05	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards. On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc. Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.
7.06.03.00	Geotechnical investigation work shall be got executed by the Contractor through the following agencies. 1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica Pvt. Ltd, New Delhi 3. KCT Consultancy Services, Ahemdabad 4. M.K. Soil Testing Laboratory, Ahemdabad

7.07.00 **Geotechnical Investigation Scheme**

a) Boreholes (Minimum)

S.N	Structure	Spacing/Number of borehole	Depth of borehole	Remarks
1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 35m to 40m.	Depth of boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier.
2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 35m to 40m.	
3	Gypsum and Lime storage area	Minimum 10 Nos.	Depth of boreholes shall be 30m to 35m	
4	Other Structure / Facility	Minimum 2 Nos. boreholes under each area / facility	30 to 35 m	
5	Chimney	Minimum 2 Nos.	40 to 45m	

b) Other Field Tests (Minimum)

1	Cyclic Plate Load Test (CPLT)	3 nos	Test Depth from 2 to 4 m	
2	Trial Pit (TP)	5 Nos.	Depth - 3 m	
3	In Situ Permeability Test In Boreholes	In minimum 3 Nos. of boreholes	Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m.	
4	ERT	Minimum 10 Nos.		

- Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work.

- Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.

Annexure-I (Yamuna Nagar)

GEOTECHNICAL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of representative boreholes solely for bidder's information in the vicinity of proposed area are enclosed at Annexure-II.

The bidder is required to carry out geotechnical investigation as per Clause No 7.06.00 & 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder.

a) The foundation system to be adopted for different structures shall be as given in Table – 1 below

Table – 1: Net Allowable Bearing Pressure

STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED
FGD and related structures	Open(with ground improvement)/Piles

b) Bidder is required to carry out geotechnical investigation in this area. During detailed engineering, the Allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure shall be lower of the two values i.e. as per approved geotechnical report and as per the values furnished in Table-2. The ground improvement scheme shall be approved by owner before execution.

Table – 2: Net Allowable Bearing Pressure

Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2		
	Isolated and combined footings		Rafts (width > 6m)
	Width upto 3.0m	Width > 3.0m upto 6m	
1.0m to 6.0m below FGL (After ground improvement using stone columns)	10	10	10

FGL Corresponds to RL(+) 270.0

In case any loose/soft pockets is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC (1:4:8).

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

c) Permissible Settlement of Foundations:

For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

Isolated, Strip & Raft (machine foundation)	25 mm
Isolated & Strip (Other than machine foundation)	40 mm
Raft (widths greater than 6 m) (Other than machine foundation)	75 mm

In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.

d) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be least of the three values i.e. as per approved geotechnical report, as per the values furnished in following table and pile capacity achieved in pile load tests.

Area/ Location	Pile Diameter (mm)	Minimum length of pile below cut-off level (m)	Safe Load Capacity in		
			Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)
FGD and related structures	600	25.0	140.0	45.0	6.0
	760	28.0	250.0	75.0	10.0

- Cut off Level (COL) is assumed at 3.0 m below FGL.

e) The criteria for Pile Termination (founding level) shall be as given below:

i) Minimum length of the pile below COL (cut off level) shall be as specified above in Clause (d) above.

ii) The minimum pile length for each group of piles shall be determined based on the nearest borelog. Pile shall be terminated into strata with SPT 'N' greater than 32 for 600mm dia pile & 760mm dia pile, while deciding the

minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby borelog data. The boreholes are in the bidder's scope and shall be conducted as per the approved scheme.

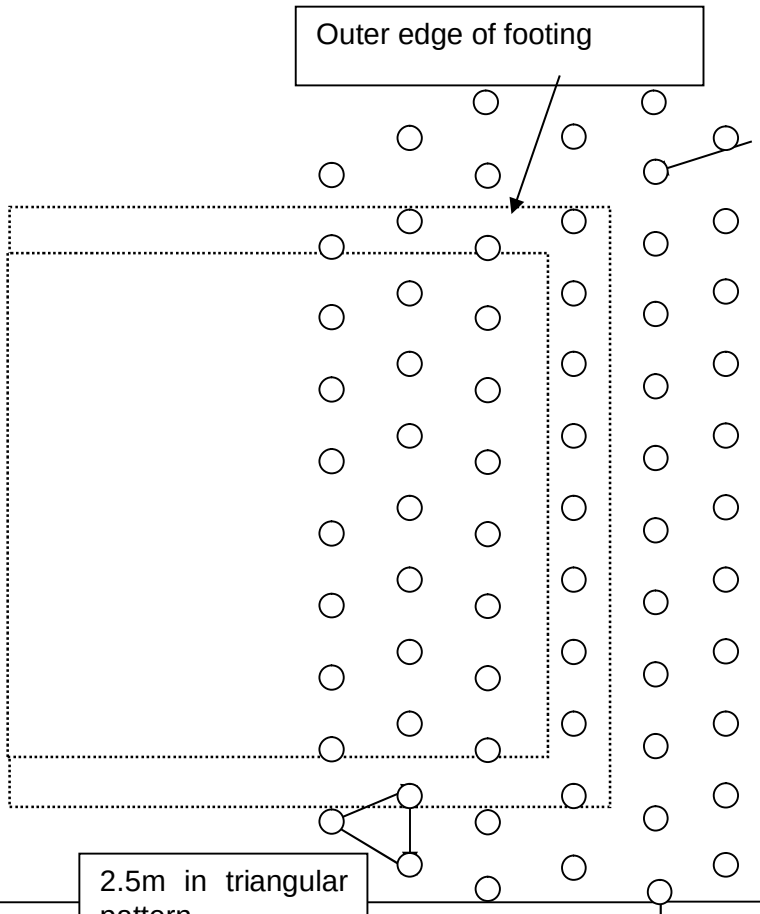
iii) However, in no case the length of pile shall be less than the minimum length determined as in (i) or (ii) above whichever is longer, for that pile group.

f) Special Requirements:

The chemicals in ground water are more than permissible limits. Sulphates and chlorides in ground water are 361 to 412 mg/l & 170 to 260 mg/l respectively. In view of the presence of chemicals following shall be adopted for all foundations and sub-structures:

Minimum cement content shall be 330 kg/m^3 and maximum free water-cement ratio shall be 0.50 for foundation works other than pile works and for pile works minimum cement content shall be 400 kg/m^3.

Pattern of stone columns (Typ.)



NOTES

- Finished diameter of stone column shall be 900 mm and depth of stone column and the stone column shall be terminated in stiff to hard silty clay layer / sand layer. Minimum embedment of stone column into this layer shall be 500mm. The minimum Standard Penetration Test (SPT) N value at the termination level shall be more than 15 as per technical specifications.

- Stone columns shall be installed in triangular pattern at 2.5 m centre to centre and installation of stone columns shall be as per technical specifications.

Two row of stone columns beyond the outer edge of footing shall be ensured.

The outer edge of footing shall be ensured.

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No 34

TERMINATION DEPTH

TABLE NO 34a

Co-ordinates 1342 N, 1145 E

Surface Elevation : 268.64 m

WATER TABLE : 2.90 m

30.45 m

JOB NO. 204123-III

Location : TG Foundation + STG Building

N-Value	Depth (m)	Sample No.	Symbol	SOIL DESCRIPTION	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Atterberg Limits: Liquid %	Plastic %	Plasticity Index %	Specific Gravity	Natural Density gms/cm³	Dry Density gms/cm³	Moisture Content %	Triaxial Test: Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
	0.00 0.50	DS1		Stiff brown clayey silt, medium plastic (MI)														
	0.50 0.80	UDS1							47.5	31.1	16.4		1.76	1.54	14.5	1,2,3 (UUT)	0.70	5°
7	1.50 1.95	SPT1																
	2.50 2.80	UDS2			0	15	53	32					1.85	1.56	18.5	0 (UC)	0.75	
8	3.00 3.45	SPT2																
				(4.3m)														
7	4.50 4.95	SPT3		Loose grey fine to medium sand with mica particles (SP)	0	96	4	0										
	5.00 6.00	DS2		- with traces of gravel, 6.0 to 7.0 m														
8	6.00 6.45	SPT4																
				(7.0m)														
	7.00 7.50	DS3		Very dense grey fine to coarse sand intermixed with gravel/ pebbles/cobbles, 40 to 80mm size (SP-GP)														
80	7.50 7.95	SPT5																
	8.00 9.00	DS4																

UUT : Unconsolidated Undrained Triaxial Shear Test
UC : Unconfined Compression Test

Grain size analysis conducted on the samples as recovered from Boreholes after chiselling

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana

BH No 34 (Cont'd) | TERMINATION DEPTH | TABLE NO 34b

204123-1

N-Value	Depth (m)	Sample No	Symbol	SOIL DESCRIPTION Location : TG Foundation + STG Building	Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index %	Specific Gravity	Natural Density gms/cm³	Dry Density gms/cm³	Moisture Content %	Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
39	9.00 9.45	SPT6		Dense grey fine to coarse sand intermixed with gravel/pebbles/cobbles, 40 to 80mm size (SP-GP)														
29	10.50 10.95	SPT7																
	11.00 12.00	DS5			38	60	2	0										
				(12.0m)														
46	12.00 12.45	SPT8		Very stiff light brown clayey silt, medium plastic (MI)														
34	13.00 13.45	SPT9																
	14.00 14.30	UDS3							46.8	30.8	16.0	2.69	1.96	1.62	21.0	1,2,3 (UUT)	0.90	6°
26	15.00 15.45	SPT10																
	17.00 17.30	UDS4		- with traces of gravel, 17.0 to 19.5 m	1	12	54	33					2.03	1.65	23.2			
13	18.00 18.45	SPT11																
				(19.5m)														
	20.00 20.30	DS6		Dense grey fine sand with mica particles (SP)														
45	21.00 21.45	SPT12		- with traces of gravel, 21.0 to 24.0 m														

Grain size analysis conducted on the samples as recovered from Boreholes after chiselling

UUT : Unconsolidated Undrained Triaxial Shear Test

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No 34 (Cont'd)

TERMINATION DEPTH

TABLE NO. 34c

Co-ordinates 1342 N, 1145 E

Surface Elevation : 268.64 m

WATER TABLE : 2.90 m

30.45 m

JOB NO 204123-III

Location : TG Foundation + STG Building

N-Value	Depth (m)	Sample No	Symbol	SOIL DESCRIPTION	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Atterberg Limits: Liquid %	Plastic %	Plasticity Index %	Specific Gravity	Natural Density gm/cm³	Dry Density gm/cm³	Moisture Content %	Triaxial Test: Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
	22.00 23.00	DS7		Very dense grey fine sand with traces of gravel and mica particles (SP)														
51	24.00 24.30	SPT13A																
	24.30 24.45	SPT13B		(24.3m) Hard brown clayey silt, medium plastic (MI)					43.8	29.2	14.6							
	25.00 26.00	DS8		(25.0m) Very dense grey fine sand with mica particles (SP)														
54	27.00 27.45	SPT14																
	28.00 29.00	DS9																
101	30.00 30.45	SPT15																
				(30.45m)														

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No 43

TERMINATION DEPTH

TABLE NO 43a

Co-ordinates 1265 N, 1378 E

Surface Elevation : 268.73 m

WATER TABLE : 3.24 m

30.45

JOB NO. 204123-III

N-Value	Depth (m)	Sample No	Symbol	SOIL DESCRIPTION Location : ETP	Grain Size Analysis				Atterberg Limits			Specific Gravity	Natural Density gms/cm³	Dry Density gms/cm³	Moisture Content %	Triaxial Test		
					Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index %					Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
	0.00 0.50	DS1		Stiff brown clayey silt, medium palstic (MI)														
	0.50 0.80	UDS1											1.76	1.52	15.7			
8	1.50 1.95	SPT1																
	2.50 2.80	UDS2			0	10	56	34	46.6	30.7	18.5	2.68	1.84	1.55	18.6	0 (UC)	0.76	
				(3.0m)														
9	3.00 3.45	SPT2		Loose to medium dense grey fine sand with mica particles (SP) - loose, 3.0 to 4.0m - medium dense, 4.0 to 7.0m														
	4.00 4.50	DS2																
10	4.50 4.95	SPT3																
	5.00 6.00	DS3																
14	6.00 6.45	SPT4																
				(7.0m)														
	7.00 7.50	DS4		Medium dense grey fine to coarse sand intermixed with pebbles / cobbles, 20 to 50mm size and mica particles (SP-GP)														
22	7.50 7.95	SPT5																

UC : Unconfined Compression Test

(Contd on Table No 43b)

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No. 43 Cont'd

TERMINATION DEPTH

TABLE NO. 43b

Co-ordinates

Surface Elevation

WATER TABLE

JOB NO. 204123-III

N-Value	Depth (m)	Sample No	Symbol	SOIL DESCRIPTION Location : ETP	Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index %	Specific Gravity	Natural Density gms/cm³	Dry Density gms/cm³	Moisture Content %	Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
	8.00 9.00	DS5		Medium dense to dense grey fine to coarse sand intermixed with pebbles / cobbles, 20 to 50mm size and mica particles (SP-GP)	39	60	1	0										
23	9.00 9.45	SPT6		- medium dense, 7.0 to 13.0m														
17	10.50 10.95	SPT7																
	11.00 12.00	DS6																
10	12.00 12.45	SPT8																
55	13.50 13.95	SPT9		- dense, 13.0 to 18.0m														
	14.00 15.00	DS7																
72	15.00 15.45	SPT10																
	17.00 18.00	DS8																
				(18.0m)														
15	18.00 18.45	SPT11		Very stiff light brown clayey silt with traces of gravel, medium plastic (MI)														
				(20.0m)														
	20.00 21.00	DS9		Medium dense grey fine to coarse sand intermixed with gravel (SP-GP)	33	64	3	0										
				(21.0m)														

Grain size analysis conducted on the samples as recovered from Boreholes after chiselling

(Contd. on Table No.43c)

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No. 43 Cont'd

TERMINATION DEPTH

TABLE NO. 43c

Co-ordinates 1265 N, 1378 E

Surface Elevation : 268.73 m

WATER TABLE : 3.24 m

30.45

JOB NO. 204123-III

N-Value	Depth (m)	Sample No.	Symbol	SOIL DESCRIPTION	Grain Size Analysis				Atterberg Limits			Specific Gravity	Natural Density gms/cm^3	Dry Density gms/cm^3	Moisture Content %	Triaxial Test		
					Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index %					Confining Pressure Kg/cm^2	Cohesion Intercept Kg/cm^2	Angle of Internal Friction
				Location : ETP														
43	21.00 21.45	SPT12		Dense grey fine sand with mica particles (SP)														
	23.00 24.00	DS10																
46	24.00 24.45	SPT13																
	26.00 27.00	DS11		- with traces of gravel, 26.0 to 27.0m														
50	27.00 27.45	SPT14																
	29.00 30.00	DS12																
45	30.00 30.45	SPT15																
				(30.45m)														

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No. 44

TERMINATION DEPTH

TABLE NO. 44a

Co-ordinates 1210 N, 1215 E

Surface Elevation : 268.48 m

WATER TABLE : 3.15 m

30.45

JOB NO. 204123-III

N-Value	Depth (m)	Sample No	Symbol	SOIL DESCRIPTION Location : WTP PH	Grain Size Analysis				Atterberg Limits			Specific Gravity	Natural Density gms/cm^3	Dry Density gms/cm^3	Moisture Content %	Triaxial Test		
					Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index %					Confining Pressure Kg/cm^2	Cohesion Intercept Kg/cm^2	Angle of Internal Friction
	0.00 0.50	DS1		Firm brown clayey silt, medium palstic (MI)														
	0.50 0.80	UDS1		(1.0m)					44.3	29.5	18.5		1.79	1.53	16.8	0 (UC)	0.78	
5	1.50 1.95	SPT1		Loose light brown sandy silt, low plastic (CL)														
	2.50 2.80	UDS2		(3.0m)	0	36	51	13					1.86	1.56	19.0			
8	3.00 3.45	SPT2		Loose to medium dense grey fine sand with mica particles (SP) - loose, 3.0 to 5.0m														
	4.00 4.50	DS2			0	97	3	0										
9	4.50 4.95	SPT3																
	5.00 6.00	DS3		- medium dense, 5.0 to 8.0m														
18	6.00 6.45	SPT4																
	7.00 7.50	DS4																
15	7.50 7.95	SPT5		(8.0m)														

UC : Unconfined Compression Test

(Contd. on Table No 44b)

SOIL PROFILE

Project : 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH.No. 44 Cont'd

TERMINATION DEPTH

TABLE NO. 44b

Co-ordinates 1210 N, 1215 E

Surface Elevation : 268.48 m

WATER TABLE : 3.15 m

30.45

JOB NO. 204123-III

Location : WTP PH

N-Value	Depth (m)	Sample No.	Symbol	SOIL DESCRIPTION	Grain Size Analysis: Gravel %	Sand %	Silt %	Clay %	Atterberg Limits: Liquid %	Plastic %	Plasticity Index %	Specific Gravity	Natural Density gms/cm³	Dry Density gms/cm³	Moisture Content %	Triaxial Test: Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
	8.00 9.00	DS5		Medium dense to dense grey fine to coarse sand intermixed with pebbles / cobbles, 40 to 80mm size and mica particles (SP-GP)	25	74	1	0										
27	9.00 9.45	SPT6		- medium dense, 8.0 to 12.0m														
29	10.50 10.95	SPT7																
	11.00 12.00	DS6		- dense, 12.0 to 13.0m														
32	12.00 12.45	SPT8		(13.0m)														
49	13.50 13.95	SPT9		Hard light brown clayey silt with traces of gravel, medium plastic (MI)														
	14.00 14.30	UDS3							42.9	28.8	14.1		1.98	1.64	21.0	1,2,3 (UUT)	1.05	6°
30	15.00 15.45	SPT10																
	17.00 17.30	UDS4										2.69	2.05	1.66	23.5			
26	18.00 18.45	SPT11																
	20.00 21.00	DS7		(21.0m)														

Grain size analysis conducted on the samples as recovered from Boreholes after chiselling

UUT : Unconsolidated Undrained Triaxial Shear Test

SOIL PROFILE

Project: 2X300 MW DCR Thermal Power Station at Yamuna Nagar, Haryana.

BH No. 44 Cont'd

TERMINATION DEPTH: 30.45

TABLE NO. 44c

Co-ordinates: 1210 N, 1215 E

Surface Elevation: 268.48 m

WATER TABLE: 3.15 m

JOB NO. 204123-III

N-Value	Depth (m)	Sample No.	Symbol	SOIL DESCRIPTION	Grain Size Analysis				Atterberg Limits			Specific Gravity	Natural Density gms/cm³	Dry Density gms/cm³	Moisture Content %	Triaxial Test		
				Location : WTP PH	Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index %					Confining Pressure Kg/cm²	Cohesion Intercept Kg/cm²	Angle of Internal Friction
47	21.00 21.45	SPT12		Dense to very dense grey fine to medium sand with mica particles (SP)														
	23.00 24.00	DS8		- dense with traces of gravel 21.0 to 24.0m														
77	24.00 24.45	SPT13		- very dense, 24.0 to 30.45m														
	26.00 27.00	DS9			0	97	3	0										
36	27.00 27.45	SPT14																
	29.00 30.00	DS10																
62	30.00 30.45	SPT15																
				(30.45m)														

NORTH

ENTRANCE FROM COLONY

1438.525(E)
2010.311(N)

K1

WATCH TOWER

M

1522.127(E)
2008.470(N)

M1

8.13

1528.762(E)
2000.894(N)

M2

1521.120(E)
1916.428(N)

N 2000.0M

N 1900.0M

N 1800.0M

N 1700.0M

N 1600.0M

N 1500.0M

N 1400.0M

N 1300.0M

SPACE FOR FGD
RL(+)269.5M

1498.791(E)
1745.238(N)

N

1498.802(E)
1660.700(N)

N1

N2

8.13

1490.791(E)
1652.128(N)

1518.30(E)
1618.68(N)

1415.27(E)
1564.16(N)

CL OF STACK
E 1369.04 M

CL. ROAD
N 1564.160 M

1429.77(E)
1542.47(N)

1540.13(N)
1314.84(E)

E.S.P. CONTROL ROOM (UNIT- 2)

STORE BUILDING

70500

28000

SPACE FOR FGD
RL(+)270.0M

CL OF BOILER(#2)
N 1496.88

BUFFER HOPPER & DUM METTING UNIT

CL OF STACK
N 1452.64

CL OF BOILER(#1)
N 1408.39

1426.77(E)
1463.01(N)

SITE OFFICE

SPACE FOR FGD
RL(+)270.0M

1511.767(E)
1437.720(N)

WORK SHOP

ASH WATER RECIRCULATION CLARIFIER

ASH WATER PUMP HOUSE

SPACE FOR FGD
RL(+)270.0M

EDGE OF PAVEMENT

E=1275.040
N=1372.390

BC-5A/5B

1268.686(E) 1331.646(E)
1326.65(N) 1326.650(N)

E=1460.240
N=1316.450

1293.45(E)
1300.21(N)

DM PUMPS

E=1251.024
N=1267.870

CLARIFIED WATER / FIRE WATER PUMP HOUSE

1333.81(E)
1243.66(N)

CLARIFIED WATER RESERVOIR

SLUDGE THICKENER

1354.109(E)
1234.001(N)

E 1300.0M

E 1400.0M

E 1500.0M

E 1600.0M

FORMATION LEVEL OF FGD AREA — RL(+)269.5M, 270.0M

NOTES: –

1. ALL DIMENSIONS ARE IN MILLIMETRE AND PLANT GRIDS ARE IN METRES UNLESS NOTED OTHERWISE.
2. FINISHED GROUND FLOOR LEVEL OF POWER HOUSE BUILDING AS EL.(±)0.00 WHICH CORRESPONDS TO RL. 270.50M.
3. AREA IDENTIFIED FOR FGD FACILITIES AS SHOWN IN THE GENERAL LAYOUT PLAN.
4. EXISTING PIPE/CABLE TRESTLES PASSING THROUGH THE PROPOSED FGD AREA SHALL BE RETAINED, AND FGD LAYOUT SHALL BE PREPARED ACCORDINGLY. BIDDER TO TAKE NECESSARY PRECAUTION AND SHALL BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING FACILITIES/PIPE/CABLE TRESTLES ETC.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	CLEARED BY C	CLEARED BY M	CLEARED BY E	CLEARED BY C&I	APPD	DATE
A	FOR TENDER PURPOSE	T.S	KKC	A.K	A.K	R.S/M.K			SK	29.05.19

OWNER: HARYANA POWER GENERATION CORPORATION LIMITED

CONSULTANT:

PROJECT: DCR THERMAL POWER PROJECT
YAMUNA NAGAR UNIT 1&2
(2X300 MW)

TITLE: **GENERAL LAYOUT PLAN**

SIZE	SCALE	DRG.NO.	REV.
A1	---	**9944-251-POC-F-002**	A

cad file name : 9944-251-POC-F-002

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**

1.04.01 The Contractor's scope of work includes supply of paints and painting of all equipment and structures as per the Employer’s standard color coding scheme which shall be furnished to the Contractor during detail engineering stage. The painting of various components shall comply with the requirements stipulated in different part of this specification. However, for components where no specific requirement is stipulated, the painting 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.
1.04.02	The flue gas swept surface of Absorber inlet ducting (excluding wet dry interface section) shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard and applied with of 50 microns of ethyl silicate zinc primer (suitable upto minimum 400 degree Celsius).
1.04.03	For flue gas ducts, gates and dampers, surface preparation shall be SP3/SP4 and Heat Resistant Aluminium Paint to IS:13183 Gr-II with two coats of minimum DFT of 20 microns each shall be applied.
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 equipment 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 equipment, 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 equipment/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 equipment/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 equipment/ 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 equipment 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 equipment/ instruments shall be compatible with the service conditions expected during pre-commissioning/ commissioning activities.

1.05.08 All temporary equipment 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 equipment 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 not applicable 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 HPGCL 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 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 Equipment**

One set of all special tools and tackles including testing, calibrating and measuring instruments required for erection, assembly, disassembly and maintenance of all equipment/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.

1.11.00 Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc. and will be in owner's scope. However, site clearance like removal of bushes, vegetation etc. is in bidder's scope.

Existing Pipe /cable trestles, conveyors etc. passing through the proposed FGD area shall be retained, and FGD layout shall be prepared accordingly.

The bidder shall take all necessary precautions to protect the entire existing equipment, 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.

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 hindrance and evident facilities (over ground and underground) 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.

However, any dismantling / relocation of non-evident underground facilities, if required and agreed to be dismantled/relocated by the Engineer in-charge, shall be done by the employer.

1.12.00 Works/Services for Comprehensive Operation & Maintenance

1.12.01 Bidder has to mandatorily undertake a comprehensive Operation and Maintenance (O&M) for FGD system installed by bidder including supply of spares and consumables required for O&M services with an annual availability of more than 95% from the date of Taking Over of the plant by Owner after completion of initial operation up to two (02) years (definition of initial operation as defined in Part-C of the specification). Bidder must comply for O & M for two (02) years with specified payment philosophy. O & M including the following will be in bidder's scope.

1. Supply of all spares from OEM vendors for two (02) years.
2. Operation and Maintenance staff including O&M supervision staff and labour required for two (02) years.

1.12.02 The O&M cost for first year shall be paid at the rate of 2 % of the total awarded project cost. The O&M cost for second year shall be paid at the rate of 2.06 % of the total awarded project cost. Payment for O & M charges will be paid in each year on monthly basis.

1.12.03 General scope of works/services for comprehensive Operation & Maintenance are as defined in Part-B of the specification.

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 **DCRTPP, Yamuna Nagar (2x300 MW)** as detailed in this specification. Steam generator in the project is Sub-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 Limestone 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-IV (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 a common absorber for both units, common limestone milling systems and common gypsum dewatering system for the project. The contractor shall also supply an auxiliary absorbent tank, common for both the units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorber, 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. All ducting, dampers, expansion joints, pumps, valves, supports, structures etc. as required for completeness of system of absorber, common limestone grinding system & common gypsum dewatering system shall also be in the scope of the contractor for the project.

2.00.00 SYSTEM DESCRIPTION

2.01.00 The FGD system shall be based on Wet Limestone Forced Oxidation process. Both units shall be provided with a common absorber.

2.02.00 Gas from terminal point on ID fan discharge duct shall be taken to the common absorber through Booster Fans. In the common 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. Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper 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 common absorber by limestone slurry pumps.
2.06.00	The gypsum from the absorber 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 vacuum belt filters for gypsum dewatering. The water removed from the absorber shall be recycled to the absorber. 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. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor. The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor to be provided by the Contractor.
2.07.00	An auxiliary absorbent tank shall be provided for storage of absorber slurry of the absorber along with slurry pumps for pumping the slurry back to the absorber.
3.00.00	**LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM**
3.01.00	The contractors scope shall include a common limestone grinding system for both 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 both 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 both 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 both the units at Design point, complete with all accessories and Agitator(s).

3.01.04	2x100% limestone slurry pumps for the absorber connected to each of the limestone slurry tank. Each pump catering to slurry requirement of the absorber.
3.01.05	Limestone slurry piping to the 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	A common Limestone Forced Oxidation (LSFO) type absorber system shall be provided for both the units. The 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 ducts of both the units (with interconnection) to absorber tower & from absorber outlet to wet stack chimney.
4.01.04	2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type / positive displacement (Helical lobe) type with VFD drive, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank.
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 of minimum capacity of 1000 kgs for the Absorber of height of more than 20 m.
4.01.11	All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed in a shed provided with roof sheeting to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line, however, if it is not possible due to layout constraints, in such case, arrangement for handling & maintenance should be properly & optimally designed. The shed 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.
5.00.00	**GYPSUM DEWATERING SYSTEM**
5.01.00	The employer envisages a common gypsum dewatering system for both the units. The common dewatering system shall receive the gypsum slurry from the common absorber through slurry feed pipes and shall comprise of two sets of dewatering equipment.
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 both 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 the 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 Contractor shall provide an auxiliary absorbent tank of sufficient capacity for storage of total absorber slurry.
6.02.00	The contractor shall provide 1x100% slurry pump for pumping the slurry back to the absorber 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**
7.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of both the units) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of both 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 clarified water system from terminal point. The two tanks shall be interconnected with an isolation valve.
7.01.01	2x100% Process Water Pumps connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of both units.
7.02.00	2x100% Mist Eliminator Wash Water Pump connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of both units. 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	Two (2) clarified water Storage tanks (each tank catering to the clarified water requirement for one vaccum Belt Filter) along with two numbers of 2x100 % clarified Booster water pumps, if required, 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 replacable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness 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. 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 the 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 along with aluminum cladding, lagging, reinforcement wiremesh, cleats and supports, shall be provided for all the equipment/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, Compressors, Gypsum Dewatering System & FGD control room. Slurry re-circulating pumps & Oxidation blowers shall be located in a shed provided with roof sheeting. The buildings/structure 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.
12.00.00	Contractor shall provide Corrosion protection painting for structures & equipment 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-A2.
17.00.00	Contractor shall provide firefighting system as detailed in Sub-Section III-A3.
18.00.00	Contractor shall provide Equipment Cooling Water system as detailed in Sub-Section III-A4.
19.00.00	Contractor shall provide Limestone & Gypsum handling & storage system for FGD as detailed in Sub-Section III-A5.
20.00.00	The scope of civil works shall be as per Sub-Section-III D.
21.00.00	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.
22.00.00	**Booster Fan & Isolation Gates**
22.01.00	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 1 to 6 above) common to bearing lubrication and for servo motor operation to each 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.
22.02.00	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.
23.00.00	Contractor shall provide Low Height Wet Chimney(s) as per the criteria & specifications specified elsewhere in the specification for the project.
24.00.00	**Wet Stack Condensate Collection System**
24.00.01	Wet stack 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.
24.00.02	Drain piping shall be of suitable material from corrosion point of view.
24.00.03	All Stack liquid collection shall be easily accessible for O&M.
24.00.04	The design of the stack condensate collection system shall be provided by the bidders in its bid.
24.00.05	Bidder should provide the condensate collection system such that the condensate collected shall be routed to the absorber by gravity, bidder should ensure safe discharge to the absorber. However, in-case of the distance between absorber and wet stack is considerably far, bidder should provide the condensate collection system such that condensate shall be collected in a storage tank and pumped to absorber. Tank shall be placed at zero meter with a capacity 5 m3/hr along with associated pumping system. Storage tank shall be complete with stack condensate collection to be pumped to absorber. Contractor shall provide 2 X100% pumps for the tank, 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.
24.00.06	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**

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 control system. Control and monitoring of air conditioning system from FGD 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.

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**

Minimum One (1) nos. of Evaporative type modular 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.

Note-1: The above list of Buildings is indicative only. Any Building under this package which are of enclosed type, shall be provided by Mechanical ventilation.
Note-2: If open shed is envisaged for any facility, then in that case no mechanical ventilation is required.

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 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 plant 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 at the discharge of air compressors (one for each air compressor).

d) Monorail with electric hoist of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more.

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

f) Complete compressed air and piping network for service air and instrument air application in FGD system shall be as per Tender drawing of compressed air system.

g) Supply of Mandatory spares as specified.

h) 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.

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

SUB-SECTION-III-A3

FIRE DETECTION & PROTECTION 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 taken from nearby existing fire water header.

1.2 HVW Spray System:

Automatic fire detection cum high velocity water spray system shall be provided for various transformers (10MVA & above OR having oil capacity 2000 liters or more) envisaged under this package. Tapping for HVW spray system shall be provided from nearby fire water 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 fire water header.

1.4 Fire Extinguishers

The contractor shall supply the following quantity (minimum) of fire extinguishers and install the same at various locations of FGD system as per TAC requirement.

1. Pressurized water type (9lit. capacity as per IS 15683): 8 Nos.
2. CO_2 type (4.5 kg Cap IS:15683): 8 Nos.
3. Dry chemical type (6 kg Cap IS:15683) : 8 Nos.

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-A4

EQUIPMENT COOLING WATER SYSTEM

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 outlet header of clarified water tank.

(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.

(i) Piping for normal makeup to ECW tank from existing DM water 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-A5

LIMESTONE & GYPSUM HANDLING SYSTEM

1.00.00 **GENERAL**

The scope of specification covers is intended to cover design, engineering, manufacturing, supply, erection, commissioning, testing and handling over of **Lime Stone Handling Plant & Gypsum Handling plant** to be installed for **Flue Gas Desulphurisation (FGD) Package.**

It is to be emphasize, that this specification does not enumerate or describe all the materials and equipment to be supplied and all the services to be performed. However, the offered systems shall be complete in every respect and shall ensure safe and reliable operation of the Plant. This means, all material and equipment shall be provided as required to make a complete, properly functioning installation and shall conform to the highest standards of engineering design, workmanship and international codes/standards.

1.01.00 Space for installation of FGD has been marked in the General Layout Plan in patches as available and before submitting his bid, the bidder should necessary visit the site and get himself familiar with the existing facilities, space availability for FGD & site constraints/condition. Accordingly, bidder has to offer the engineered solution to accommodate his system/equipment within the space identified for FGD.

1.02.00 Based on site visit & space identified for FGD, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. The layout offered shall be such that, it should require minimum modification, demolition and relocation of existing facilities and layout shall be subject to approval of employer. The layout shall covered the complete Limestone handling plant & Gypsum handling facilities and shall clearly list out the modification, demolition and relocation of existing facilities. **In the absence of above, the bid shall be deemed incomplete and may be liable for rejection.**

1.03.00 A brief scope of Limestone handling plant & Gypsum handling facilities has been elaborated in the relevant paragraphs and shall be engineered based on the **storage requirement of crushed limestone of 7 days & gypsum produced for 15 days** based on the design criteria of major equipment specified in the Technical speciation.

SYSTEM DESCRIPTION: LIMESTONE HANDLING SYSTEM

1.01.00 **Limestone Handling System**

The limestone handling system comprises the following:
(i) Unloading, Crushing and Stacking.
(ii) Reclaiming and Limestone Bunker Feeding System

1.01.01 **Unloading**, **Crushing and Bunker Feeding System**

Minimum 2 x 100% capacity Box feeders/ Bulk material receiving unit/ Truck unloading system/ Surface feeder for unloading of limestone from trucks by 2x100% capacity hydraulic operated truck tippers. This unit shall feed limestone onto the

conveyor before crusher house. The unloading trucks/trippers shall have a gross load capacity of 60T with a payload of 40Ton. The layout / area selected shall have a free movement of incoming & outgoing trucks, ample space for parking of trucks and area shall be paved area. The trucks will be weighed both in loaded and unloaded condition on the weigh bridge to be provided by bidder.

1.01.02 **Conveying**

"As received" limestone shall be fed on the 2 x100% conveyors from where the same shall be conveyed upto the crusher house. The crushed limestone shall be conveyed by 2x100% Bucket Elevator to the limestone storage silos. From silos the limestone shall be removed suitably by feeders, conveyors and feed to 2x100% Bucket Elevator and finally to limestone mill bunkers/Day Silos.

1.01.03 **Crushing**

In limestone crusher house, limestone from each incoming Conveyor shall pass through one (1) number of (dedicated) Vibrating Screening Feeder and one (1) number of (dedicated) crusher which shall crush limestone to (-) 20mm size or to suit limestone pulverizer system. Limestone sampling unit shall be provided to sample the limestone from either stream. A passenger cum goods elevator shall be provided in limestone crusher house.

1.01.04 **Limestone Storage and Bunker feeding system**

Crushed limestone shall be conveyed to limestone storage silos (minimum 2 nos. of identical capacity) via Belt Feeder & Bucket Elevator to store crushed lime stone equivalent to the consumption of minimum 7 days for the all units. The maximum capacity of each limestone silo shall not exceed 2000MT. Silo shall be provided with all accessories like manhole, vent, bag filters and other accessories to maintain flowability of limestone from silo.

From Silos, crushed Limestone of (-) 20mm size would be fed to Limestone bunkers/Day Silos through vibrating feeder, belt conveyors, Bucket Elevator, ploughs/ trippers etc.

1.02.00 SYSTEM DESCRIPTION: GYPSUM HANDLING SYSTEM

Gypsum handling system shall be provided with 2x100% conveyor stream for conveying dewatered gypsum from gypsum vacuum belt filter to closed storage shed. The storage shed shall be sized for 7 days of gypsum production with all the units in operation. Gypsum from storage shed shall be loaded to user's trucks using front end loader/ payloader.

Alternatively, Gypsum can be stored in Eurosilos/equivalent (minimum 2 Nos. to be provided). The silos shall receive gypsum by belt conveyors. The silos shall be provided with rotating auger frame and slotted column internal mechanism for controllable storage and reclamation. Further, simultaneous filling and reclaiming in layers should be possible. Silos shall have a drainage system at bottom. Silos shall permit to unload gypsum directly into trucks. Bidder/sub-vendor shall provide evidence of having executed similar types silos in atleast two thermal power stations

	and which are in successful operations for atleast one year prior to date of bid opening. Conventional type silos for gypsum storage are not acceptable.
2.00.0	**Brief Scope of Work**
	The brief scope specified herein is not exhaustive and any work required for completeness & integration of the complete system to ensuring its satisfactory running shall be in the scope of work and supply for this package.
2.01.00	**Limestone Handling Plant (LHP)**
	ROM Limestone of approx. (-)250 mm size will be received to power plant through road by trucks and shall be unloaded by 2x100% Truck Tipplers each of minimum **40T** capacity **(Gross weight 60 T minimum)** to discharge Limestone on to 2x100% of Box Feeders/ Surface Feeders/ Bulk-material Receiving Unit each of 150 TPH Capacity. This unit shall be complete for unloading of limestone from trucks/ self-tippling trucks, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc and shall feed limestone onto the conveyor before Limestone crusher house.
2.01.01	Truck tippler complex complete with ramp, dust proof enclosure, dust extraction system including all mechanical, electrical, civil and structural works.
2.01.02	Double stream Limestone Belt Conveyors LC 1A/1B of capacity 100% each complete with 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.
2.01.03	One (1) number Lime stone crusher house (CH) complete with all mechanical, civil, structural, architectural and electrical works etc accommodating crushers , associated Vibrating screening feeders, Belt feeders etc., passenger cum goods elevator, chute work, 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.
2.01.04	Two (02) numbers of vibrating screening feeders LVSF1/2 in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc.
2.01.05	Two (02) numbers of hammer crusher LCR1/2 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.
2.01.06	Two (02) numbers of feeders LBF 1/2 shall be provided for feeding the limestone to reclaim conveyors/Bucket Elevators with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc

2.01.07	Two (02) numbers of Chain type Limestone Bucket Elevators LBE1/2 complete with its supporting structures, foundations, drive motors, drive units, guides, pits , safety devices, switches, brakes, all civil and electrical etc.
2.01.08	Two (02) numbers of feeders LBF 3/4 shall be provided for feeding the limestone to Limestone Storage Silos with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc
2.01.09	Two (02) numbers of Limestone Storage Silos to store limestone equivalent to consumption of minimum 7 days at Design point (Generation of all units to be considered). The maximum capacity of each limestone storage silo shall not exceed 2000 MT. Suitable dedicated isolation and feed regulating mechanism below silos shall be provided taking feed from silo and discharging onto onward conveyors and Bucket elevators.
2.01.10	Limestone Belt Conveyors LC 2A/2B complete with 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
2.01.11	Two (02) numbers of Chain type Limestone Bucket Elevators LBE-3/4 complete with its supporting structures, foundations, drive motors, drive units, guides, pits , safety devices, switches, brakes, all civil and electrical etc
2.01.12	Two (02) numbers of feeders LBF-5/6 shall be provided for feeding the limestone to Day Silos with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc
2.01.13	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.
2.01.14	One (1) no. of Limestone sampling unit, for as received limestone in crusher house complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms, hoists etc
2.01.15	Suitable number of ploughs and its actuating mechanism shall be mounted on each conveyor to feed limestone into limestone mill bunkers/Day Silo. Alternatively, suitable nos. fixed Trippers on each conveyor to feed limestone into limestone mill bunkers/Day Silo. Bidder can also offer bucket elevator's for transferring crushed limestone to mill bunkers/Day silo.
2.01.16	Two (2) numbers of conventional enclo-sure type passenger cum goods elevator having capacity of 16 persons (1088 kg) complying to IS:14665 (latest edition) with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve vari-ous floors of limestone crusher house and Crushed Limestone Main Storage Silo. Staircase access for machine room shall also be provided by the bidder.
2.01.17	Two (2) numbers of in line magnetic separators (one no. on each conveyor feeding to crusher house) and four (4) number of suspended magnets, (one no. on each

	conveyor feeding to crusher house and one no. on each conveyor feeding to Limestone bunker/Day Silo) on conveyors. All the in line magnetic separators and suspended magnets shall be complete with reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories.
2.01.18	Four (4) numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone day silo at FGD plant) complete with all mechanical, electrical, civil, structural works and accessories.
2.01.19	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.
2.01.20	Two (2) Nos. sump pumps in each junction house if applicable completely or partially underground complete with motors, local control panel, level switches, individual discharge piping with fittings and valves .
2.01.21	Complete dust extraction system for control of fugitive dust in Truck unloading system/BRU, limestone Silos, crusher house complete with fans, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works..
2.01.22	Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works.
2.01.23	Exhaust fans to be provided in all battery rooms and all toilets.
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).
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 and gypsum handling plant, complete with all mechanical, electrical, accessories and consumables for one year of consumption. Further belt jointing facilities as specified shall be provided. Alternately, the bidder may give a common belt vulcanizing machine for LHP and GHP.
2.01.28	Minimum one (1) no. pitless type weigh bidge of capacity 100MT for Road trucks 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 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. First fill of all consumables, e.g.; oils and lubricants for one year toppings requirements.
2.01.33	Preservative shop coating, final painting of all structures and equipment.
2.01.34	All inserts, anchor bolts, foundation bolts for Contractor's equipment, platforms etc. in the entire LHP.
2.01.35	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 (4) Nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves
3.04.00	Complete dust extraction system for control of fugitive dust in gypsum storage shed.
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	Complete ventilation system for gypsum storage shed.

3.08.00	Two (2) numbers of electronic type belt scales (One no. on each gypsum conveyor feeding to storage shed) for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories. Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader. 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.
4.00.00	All electrical actuators used in this package like for Flap gates, Scoop coupling, Pump house, Dust extraction etc. shall be non- intrusive, fieldbus based integral actuators meeting requirements specified in Electrical actuators, Part-B, Section-VI.
4.00.01	For measurement of Pressure, Differential Pressure and Temperature in processline of LHP and GHP including all associated systems, Analog measurement with Fieldbus protocol (complying to Measuring Instruments (Primary and Secondary), Part-B, Section-VI) shall be provided. The above philosophy shall also be applicable for integral equipment like scoop coupling, if integral equipment supplier can provide the same. However, if integral equipment supplier provides proper technical justification for not able to do so then instruments as per Standard Practice of integral equipment supplier can be provided subject to Employer's approval. The PT, DPT and TT shall be mounted on pipes in suitable rack/ canopy arrangement. The exact arrangement shall be as approved by Employer during detailed engineering.
4.00.02	For measurement of tank level in water application ultrasonic type level transmitter and for slurry based application Radar type level transmitter are to be provided. For specification of these instruments and all other measuring instruments shall be complying to specification requirements of Part-B, Section-VI.

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, Busduct/ Cable (as applicable), distribution boards, AC/DC fuse boards, LDB, local emergency push button stations for all drives and local motor starters (for ventilation fans) as required for plant and equipment in contractor's scope.

HT Switchgear- All 11kV/6.6kV/3.3kV switchboards shall be provided with one spare motor feeder and one transformer feeder on each section as spares.

LT Switchgear- All LT Switchgears, Motor Control Centers (MCCs) & AC/DC distribution boards, etc. shall have at least twenty per cent (20%) or minimum two (whichever is higher) fully equipped switch fuse modules of each rating as spares, uniformly distributed over different vertical sections.

In addition, all LT Switchgears, MCCs and AC distribution boards shall have as spares at least twenty per cent (20%) of starter modules/MCCB modules or at least one module (whichever is higher) of each rating range of the selection tables (Clause no.42.00.00) of Tech. Specification Part-B, Sub-Section E-09, equipped for the rating of the largest auxiliary fed from that range.

Contractor's scope also include the Insulating mat for laying in front of 11kV/6.6kV/3.3kV/415V Switchgears in switchgear rooms under his 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 Sub-section-II- E1 Part-B of Technical specifications.

One set of variable metallic resistor and shunt for each battery rating & location suitable for carrying out the discharge test on the batteries under Contractor's scope shall also be supplied.

1.04.00 **TRANSFORMERS**

Transformers as per Electrical Single Line Diagram applicable and system requirement, however bidder to provide complete sizing & selection criteria of Transformer's feeding Contractor's own systems.

1.06.00 **VARIABLE FREQUENCY DRIVE (VFD)**

The VFD system shall be provided for the equipment drive motors as envisaged in relevant portions of the specifications for driven equipment. The system shall be either Voltage Source Inverter (VSI) or Current Source Inverter (CSI) type. Complete VFD system alongwith associated equipment, HT/LT panel, HT/LT cable, Transformer etc. as applicable shall be provided. Bidder to provide Air conditioned room to house Variable Frequency Drive (VFD).

1.07.00 **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. 9944-000-POE-J-001/Rev 00.

1.08.00 **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.

1.09.00 **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. 9944-000-POE-J-001/Rev 00 on the employers nearest trestle in the FGD area as shown in GLP drawing of respective plant 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 Contractor

1.10.00 **LIGHTING**

Complete lighting system for internal and external areas for the FGD system 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.

1.11.00 **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.

1.12.00 **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.

1.13.00 **CONSTRUCTION POWER**

HPGCL shall provide free power connection to the contractor and contractor shall intimate actual power requirement to HPGCL during installation and commissioning of equipments/system.

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.

1.14.00 **TYPE TEST**

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

1.15.00 **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

1.01.00a) 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 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 scope of work shall also include all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipment ensuring operability, maintainability and reliability.

d) 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.

e) 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.

f) In this project fieldbus (FF/Profibus) based instruments(PT/DPT/TT), Fieldbus based Non-intrusive Electrical actuators are also envisaged which shall be connected to the DDCMIS. The protocol of fieldbus (FF/Profibus) for non-intrusive electric actuators and fieldbus based instruments shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval.

1.02.00 In this package fieldbus based controls and conventional controls (hardwired 4-20mA/DI/DO) both are envisaged.

1.02.01

Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall be discussed and finalized during detailed engineering.

A. For fieldbus based instruments/ actuators following guidelines shall be followed:

a. Actuators which are in main and standby line shall be wired to separate host/ master of FF/Profibus.
b. Dual/Triple redundant PT/DPT/TT shall be wired to separate segments.

B. Loop Reaction Time (time between field acquisition to field output in control system):

a. For Fast Closed loop controls of conventional system, loop reaction time shall be 250ms or better as per process requirement.
b. For other Closed loop controls, conventional/ fieldbus based/ mixed, loop reaction time shall be 500 ms or better as per process requirement.
c. For Fast Open loop controls of conventional system (Tie/ trip selection), loop reaction time shall be 100ms or better.
d. For other Open loop controls, conventional/ fieldbus based/ mixed, loop reaction time shall be 1 Second or better as per process requirement.

The above shall be suitably demonstrated by the contractor.

C. For Foundation Fieldbus & Profibus PA chicken foot/ branch/ or combination of both topology shall be provided. For Profibus DP, Bus/ Line topology in redundant mode shall be provided. That is, for Profibus DP redundant cables connected to redundant ports of devices shall be provided.

Specific approval of Employer shall be taken before finalization of protocol of Fieldbus for DDCMIS and for the fieldbus based equipments being connected to DDCMIS like PT/DPT/TT and actuators.

Further, the grounding scheme of fieldbus system shall be as recommended by FF/ Profibus standards and Contractor shall submit the detailed scheme at the start of engineering for Employer's approval.

D. The design of control system cabinets with fieldbus components shall be finalized during detailed engineering stage and various requirements specified for DDCMIS cabinets in Part-B of this specification will not apply.

E. The actuators shall be fully compatible with the valves being provided in this package. Further, 5 Nos. configuration/ diagnostic tool (if applicable) for non-intrusive actuators and 5 nos. configuration/ diagnostic tool (if applicable) for all fieldbus compatible devices shall be provided for each station.

F. Twisted pair with round steel wired armour (SWA), Type A fieldbus cable complying to 61158 (detailed Specification as per PART-B), SS JBs with IP-66 and

accessories for fieldbus based instruments and actuators shall be provided by the contractor under this package.

2.00.00 **DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)**

2.01.00Latest state of the art microprocessor based Distributed Digital Control, Monitoring & Information System (DDCMIS) shall be provided comprising of the following as a minimum and meeting all requirements specified under Sub-section IIIC-05 DDCMIS of Part -B, Section-VI of Technical Specification and the following annexure of this subsection:

IIIC-05G: HMI Hardware

IIIC-05J: Security Policies and Procedures

IIIC-05K: Guidelines for Fieldbus System

The contract quantity of hardware and peripherals of HMIPIS, programming station etc. shall be as per Appendix-I to Part- A, Section-VI of Technical specification read in conjunction with detailed technical specification.

For Messaging system, wireless link and Remote Service Centre connectivity (for each type of DDCMIS) the fixed cost (e.g. service provider charges & its equipment etc.) and running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMC price for the total duration of AMC, i.e. five years.

2.02.00 **Flue Gas De Sulphurization (FGD) DDCMIS**

2.02.01 FGD System comprising of binary and modulating controls of complete Flue gas desulphurization system, material handling systems and other systems being provided under the contract, shall be implemented in the DDCMIS separately for each project. The Control System of FGD DDCMIS has following process blocks as minimum. Any other systems apart from the below mentioned systems shall be included in the common system. Details of control blocks with respect to process blocks shall be finalized during detailed Engineering:

FGD DDCMIS consisting of following:

(a) Unitized process blocks:

i. Unit-1 absorber and associated system
ii. Unit-2 absorber and associated system

(b) Common system process blocks:

i. Gypsum De watering Handling common system block.
ii. Lime stone preparation and handling common system block.
iii. Other associated common system

In addition to monitoring and control from the FGD control room, the systems indicated at (a) & (b) shall also be monitored and controlled from each Unit control room.

2.02.02	Depending on the project layout and equipments location of FGD control room and FGD sub systems such as Gypsum handling system, Limestone handling system and other systems being provided under the contract, requirement of Remote Input Output (RIO) shall be finalized during detail engineering. In such cases, contractor to provide RIO on as required basis. Contractor shall place RIO cabinets inside building with air conditioning environment. Building, Air conditioning, power supply for RIO cabinets shall be in contractor's scope.
2.02.03	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.
2.03.00	The above system(s) shall include their respective measurement system for signal acquisition, conditioning and signal distribution of various types of inputs/outputs, meeting specification requirements including respective Hardware requirements as stipulated in Sub-section IIIC-05, DDCMIS, Part-B, Section-VI of Technical Specification. The DDCMIS also envisages fieldbus (Foundation fieldbus/ Profibus) complying with IEC61158 for control and signal acquisition from fieldbus compatible actuators and instruments. Field-bus interface modules shall be provided in each FG.
2.04.00	**Human - Machine Interface & Plant Information System (HMIPIS)**
2.04.01	HMIPIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC/TCP/IP protocols, etc. shall be provided.
2.04.02	Control, operation and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD common 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) using OWS placed in CCR. The HMIPIS will include the following as a minimum: Operator Work Station (OWS) in Central Control Room (CCR) and FGD common control room. Employer shall provide 02 nos. of UPS power feeder per unit from employer's ACDB, for powering FGD OWS located in CCR. Cabling from ACDB to FGD OWS (located in CCR) shall be in bidder's scope of supply.

	Processing Stations (Servers/Workstations) in redundant configuration including RAM, dual bulk memory etc. Removable storage Media shall be used for historical storage and retrieval and long term storage and retrieval of data. Redundant LAN for communication between various OWS, between OWS and processing stations and OWS. A redundant station-wide LAN for connecting the unitized and common systems of FGD DDCMIS as well for connecting to Employer's Station LAN through firewall. This shall include all cables and accessories required for connecting Contractor's system upto the Employer's systems such as Station LAN, etc. Alternatively, Bidder's standard & proven solution, which is functionally equivalent to redundant system bus and single fault tolerant, shall be acceptable.
2.04.03	Adequate measures shall be provided for the security of the DDCMIS including the interface to Employer's Station LAN as detailed at Part-B, subsection DDCMIS. This includes Redundancy in firewall, Connection to Contractor remote service center through VPN technology, etc.
2.04.04	Suitable hardware/software for interfacing of FGD DDCMIS with following systems (i) Employer's Station LAN. (ii) Remote diagnostic station for FGD DDCMIS at OEM end.
2.04.05	DDCMIS vendor shall upgrade/ update all DDCMIS system along with release of DDCMIS system software/ patches, meeting the system software requirements as mentioned in DDCMIS chapter, Part-B, SECTION-VI. This shall include the latest supported OS and its corresponding latest version/ release of DDCMIS system software/ patches. The upgrade/ update shall be carried out in the penultimate year of AMC (In case of one year AMC, third month from the date of commencement of AMC). Any change in hardware required for the same shall also be carried out by the contractor within the contract price.
2.05.00	**Data Communication System** System Bus connecting Control System and HMIPIS. Other bus systems for connecting various systems/subsystems of DDCMIS like Cubicle Bus, Local Bus, I/O Bus (Including Remote I/O Bus) soft links (including those from Field Bus based temperature transmitter) as well as within systems/sub-systems of DDCMIS. All the bus systems shall be redundant except for back plane buses which can be non-redundant.
2.06.00	**Remote Input/ Output Modules** Remote input / output modules and cubicles for locations identified during detailed engineering, in the plant for the signals, which are used for information and Control / Interlock purpose, are to be provided.
2.07.00	**Annunciation Function**

	The annunciation system shall be built as a part of the control system of the DDCMIS.
2.08.00	**System programming, diagnostics & documentation facility**
2.08.01	The programmer station shall be provided for configuration/tuning/structuring of control system and program development /modification of HMIPIS. A Workstation based system documentation facility for automatic generation of system documentation shall be provided to achieve paperless documentation for the project. The diagnostic system shall have elaborate diagnostics facility giving details of fault in I/O modules, other modules and cabinets on OWS in form of display and text messages.
2.08.02	Software for determining optimum controller settings for control loops shall be supplied as per subsection DDCMIS, Part-B, Section VI for each unit.
2.09.00	**Power Supplies**
	Redundant power supply modules/packs for powering the systems described above in system cabinets with necessary auctioneering and distribution.
2.10.00	**Cabinets**
	(a.) System cabinets housing electronic modules and power pack supplies of system described above.
	(b.) Marshalling cabinets separate from system cabinets for terminating inputs from field, MCC/SWGR etc., for further wiring to control system and for terminating outputs from control system to MCC/SWGR etc. In case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided.
	(c.) Relay cabinet-housing relays for providing contact outputs by control system to other system wherever contacts are used in circuit/scheme of Control supply/power supply of more than 24 V and in cases where the VA burden is more than the VA burden the Output module can drive. Alternatively, these relays can also be mounted in termination/marshalling cabinets also. It may be noted that relays cannot be mounted in system cabinets.
	(d) In case DDCMIS supplier can provide system cabinet with suitable partition to create separate marshalling area on the rear side of the system cabinet,

ensuring that dust ingression does not take place in system area, the same can also be accepted subject to Employer's approval during detailed engineering stage.

(e) The design of control system cabinets with fieldbus components shall be finalized during detailed engineering stage. The contractor shall propose suitable design of these cabinets keeping in view, ease of operation and maintenance and minimizing entry of dust to cabinets for Employer's approval.

2.11.00 Warranty and Annual Maintenance Contract

Warranty and Annual Maintenance Contract (AMC) for DDCMIS, as per Sub-section IIIC-05 DDCMIS, Part -B, Section-VI of Technical Specification.

2.12.00 Representative of OEM shall also be required to be present during Factory Acceptance Testing (Authorization to shipment test ATST) of respective DDCMIS for testing of finally implemented control system. Logic/HMI implementation for various DDCMIS system shall be done in Uniform way and documents of these shall be furnished in uniform format, as approved by Employer.

2.13.00 Control System Spare Capacity

2.13.01 Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, DDCMIS shall have spare "Usable" capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:

2.13.02 20 % spare channel shall be provided in each functional groups for each type of input / output fully wired up to the marshalling/ termination TBs.

2.13.03 Wired-in "usable" space for 20% modules along with Field Terminal assemblies, PCB/Connectors (if any in the offered system) in each of the system cabinets for mounting electronic modules shall be provided by the Contractor for future use.

2.13.04 Each controller shall have 40% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type mentioned in clause 2.13.02 & 2.13.03 above, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of controller.

2.13.05 Ten (10) percent spare relays of each type and rating, mounted and wired in relay cabinets. All contacts of relays shall be terminated in terminal blocks of relay

	cabinets. In each of the relay cabinets, 10 % spare terminal blocks shall be provided so that additional relays can be mounted and wired.
2.13.06	Twenty (20) percent spare terminal blocks in each marshalling cabinets.
2.13.07	The spare capacity as specified above shall be uniformly distributed throughout all functional groups. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers/ cabinets in the system delivered at site. Further, these additions shall not deteriorate the system parametric requirements like response time / duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement.
2.13.08	The above mentioned requirements are generally applicable for conventional system. For fieldbus based system refer Annexure IIIC-05K of Part-B for spare requirements. In FGs where mix of conventional and fieldbus based system is used, the spare shall be in the respective proportion.
2.14.00	The contractor has to provide KKS codes for instrument and drives in the P&ID and other related document.
2.15.00	Output redundancy is applicable for 10% of drives including MOVs, Pneumatic On/Off / Control valves, Electrical breakers etc. distributed in various functional groups. Exact application shall be finalized during detailed engineering.
2.16.00	Complete wiring / cabling from field devices to panels / MCC and vice versa including conduits / trays / fixtures etc. shall be in bidders scope.
3.00.00	**MEASURING INSTRUMENTS**
	The following shall be provided as a minimum, meeting specification requirements of Sub-section IIIC-2 - MEAS INST of Part-B, Section-VI of Technical Specification.
3.01.01	Primary instruments like Microprocessor based transmitters employing HART/ Fieldbus 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 monitoring system (VMS) 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) All Instruments which are Integral to equipment like pumps, motors etc. / skid mounted instruments and are not indicated in enclosed drawings (as applicable) included in relevant sub-sections, but are required for control, monitoring and operation of the equipment/plant/ Systems are to be provided by the Contractor to meet actual system requirements meeting redundancy and other requirements specified under technical specifications subject to Employer's approval. Specification / type of instruments shall be as per standard and proven practice of equipment supplier. However, for temp elements including bearing / winding temp of motors / pumps temp transmitters shall be provided.

(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. Microprocessor based vibration monitoring system shall be provided for Booster Fans, Limestone Crusher, Milling System and all other equipments operating on 11kV/ 6.6kV/ 3.3kv. The number of bearing locations to be monitored on each equipment shall be as per requirements finalized during detailed engineering but not less than 2 (X and Y direction) bearing locations (except for vertical pumps for which one bearing location may be sufficient).

(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.

3.01.02 All Pressure Transmitters, Differential Pressure Transmitters and Temperature Transmitters in this package shall be provided based on Fieldbus protocol (complying to specification of Part-B, Section-VI). The protocol of fieldbus based instruments shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer’s approval.

3.01.03 Vibration monitoring system panel shall be placed in FGD control room.

3.02.00 All weather analyser panel located in air conditioned containerised room (Portable cabin) or air conditioned analyser room shall be provided for housing analysers except In situ analysers. For balance instruments local panels which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved by Employer during detail engineering.

3.03.00 **CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)**

3.03.01 CEMS comprising of analysers and associated items for measurement of SO2, NOx, CO, CO2, Mercury, Particulate Matter (dust density), and Stack Flue Gas Flow in Stack emission shall be provided for each flue by the Contractor for stack emission monitoring.

A) **LIST OF FLUE GAS EMISSION ANALYSERS FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)**

S. No.	KKS CODE	DESCRIPTION	RANGE	ZONE	REMARK
1	HNE10CQ005	SO2 in stack emission	0-250 /0-1500 mg/Nm3 (SELECTABLE)	CHIMNEY	
2	HNE10CQ001	NOX in stack emission	0-250 /0-1500 mg/Nm3 (SELECTABLE)	CHIMNEY	Refer note-2
3	HNE10CQ002	CO2 in stack emission	0-25% (Selectable)	CHIMNEY	
4	HNE10CQ004	CO in stack emission	0-100/ 0-1000 mg/Nm3 (SELECTABLE)	CHIMNEY	
5	HNE10CQ003	Particulate Matter (Dust Density) in stack emission	0-50 mg/Nm3 / 0 – 300 mg/Nm3 (PROGRAMMABLE)	CHIMNEY	
6	HNE10CQ006	Mercury (Hg) in stack emission	0 - 35 microgram/Nm3	CHIMNEY	
7	HNE10CQ007	Flue Gas flow at stack	To be Decided during Detail Engineering.	CHIMNEY	

NOTES:

1. SO2, NOX, CO2 and CO analyser are shown separately for the purpose of input only otherwise SO2, NOX, CO2 and CO analyser may be supplied as a single unit/ Combined Unit (s) meeting specification requirement.

2. Direct measurement of NO and NO2 shall be done. Total NOx values shall be reported as NO2 i.e. NOx = NO + NO2 = NO X 1.53 + NO2 = NOx as NO2.

3. Oxygen (O2) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO2, NOx and Particulate matter value corresponding to the standard/reference O2.

4. CEMS Parameters shall be normalized for temperature, pressure,

	moisture (applicable in case of wet measurement techniques), etc.. This facility shall be available in the respective analysers. Necessary measurement shall be provided by the Contractor for these parameters. All the CEMS parameters shall be reported on dry basis. 5. CO2 Measurement at stack and at instrument end shall be provided in case dilution techniques are used. 6. Offered CEMS should comply with latest CPCB/regulatory requirement prevailing at the time of award of the contract even if same is not explicitly indicated in the technical specification, without any cost implication to the Employer. 7. Offered CEMS shall be fully proven for the actual flue gas parameters at stack. Reference list and user feedback of offered CEMS in similar applications shall be furnished to Employer for review during detailed engineering stage. 8. These are per absorber quantities.
3.03.02	CEMS analysers/instruments shall be provided with single point bidirectional connectivity over RS-232/RS-485 Modbus Protocol/ Ethernet TCP/IP protocol 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),CPCB Guidelines July-2017 on CEMS 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. Bidder shall connect analysers/instruments of his scope and provide single point/port **in FGD control room** for connection with Employer's cloud server. Further connection to Employer's cloud server shall be in the scope of Employer. 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 Employer's agency involved in implementation of above connectivity.
3.03.03	For CEMS - In addition to above requirement, 4-20 mA connectivity to DDCMIS shall be provided by the Contractor.
3.03.04	Comprehensive Annual Maintenance Contract (AMC) for five (05) years after warranty period shall be provided by the contractor for CEMS and Analysers of FGD System.
3.04.00	**SERVICES DURING DEFECT LIABILITY PERIOD FOR CEMS AND ANALYSER INSTRUMENTS OF FGD**
3.04.01	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.

3.04.02	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.
3.05.00	**SERVICES DURING ANNUAL MAINTENANCE CONTRACT (AMC) PERIOD FOR CEMS AND ANALYSER INSTRUMENTS OF FGD**
3.05.01	The Contractor shall provide complete maintenance services for each System under comprehensive Annual Maintenance Contract (AMC) for an additional period of two years after the end of Comprehensive Operation & Maintenance period.
3.05.02	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.
3.05.03	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.
3.05.04	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.
3.05.05	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.
3.06.00	**DEPUTATION OF ENGINEER/ TECHNICAL EXPERT FOR CEMS AND ANALYSER INSTRUMENTS OF FGD**
3.06.01	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.

3.06.02	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.
3.07.00	Not Used.
3.08.00	Contractor shall provide one no. of Hand held HART calibrator per generating unit.
4.00.00	**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 IIIC-3 PCP, Part-B, Section-VI of Technical Specification. All transmitters, switches, temperature transmitters etc shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas. The instruments (electronic transmitters, temperature transmitters, level transmitters, flow transmitters/ flow meter) etc which are not located inside covered building shall be grouped (two or more) and mounted inside instrument racks. In case grouping is not possible and these are to be installed individually, canopy with suitable arrangement shall be provided. The grouping and design of racks/ canopy shall be approved by Employer during detail engineering. Additionally, the same philosophy shall be applicable for switches except for those mounted on pipe and equipment. All electric actuators, pneumatic control valves, JBs ,SOV box and Local control panels which are not installed inside covered building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.
5.00.00	**INSTRUMENTATION CABLES, C & I SYSTEM, POWER SUPPLY DISTRIBUTION CABLES & CABLE SUB-TRAYS**
5.01.00	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 IIIC-4 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 FGD DDCMIS 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 with requisite terminals shall be provided on as required basis. Grouping, Assignment, Sequence of termination of various field instruments /drive signals (if applicable) to Local junction boxes shall be subject to Employer's approval during detailed engineering.

6.00.00 CONTROL VALVES & ACTUATORS

6.01.00 Control valves, actuators and accessories, shall be provided on as required basis for meeting requirements specified under Sub-section IIIC-07 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.

6.02.00 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.

7.00.00ELECTRICAL POWER SUPPLY

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 DDCMIS 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 stipulated under Part B, Section VI. Contractor shall provide Mini UPS for each server station as minimum.

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 Part B, Section VI. 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-C10, Part B Section VI of technical specifications.
8.00.00	**TYPE TEST REQUIREMENT** The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section-IIIC-06 Type Test Requirements, Part-B, Section-VI of Technical Specification.
9.00.00	**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.
10.00.00	Interfacing with Employer's DDCMIS
10.01.00	Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS/ CHP DDCMIS (under Employer's scope) and FGD DDCMIS (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 to consider IOs and cables for minimum number of hardwired signal exchange per unit as follows DI – 130, DO – 130, AI – 50 and AO – 50.
10.02.00	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.
10.03.00	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.
10.04.00	Contractor to refer the General Layout Plan (GLP) to estimate the distance between FGD control room and Employer's CCR/CER.
11.00.00	**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 Sub-Section titled "Basic Design Criteria" in Part-B, of this Technical Specification.

12.00.00 Electric Actuators

Fieldbus based Non-Intrusive Electrical 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 specified elsewhere in the Technical specification.

For detailed specification refer chapter "Electric Actuator", Part B, Section-VI. These actuators shall comply the common requirements of actuators as specified at clause 2.00.00 and specific requirements of Non-Intrusive fieldbus actuators as specified at clause 4.00.00. Specific requirements of Non-Intrusive hardwired actuators specified in clause no. 3.00.00 are not applicable for this project. For Blade pitch actuators specification clause no. 5.00.00 shall be complied.

The protocol of fieldbus based non-intrusive electric actuators shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval.

For erection and commissioning of above specified actuators, qualified and experienced engineers of actuator manufacturer shall be deputed at site. After successful commissioning of actuators, minimum one qualified and experienced engineer of main package supplier/ actuator manufacturer shall be continuously available at site up to completion of defect liability period (warranty) of actuators, for troubleshooting and maintenance of actuators and proper interfacing with DDCMIS. Qualified and experienced engineers indicated above shall have expertise in all aspects of non-intrusive actuators along with fieldbus protocol and interfacing with DDCMIS.

13.00.00 CONTROL DESK, PANELS AND FURNITURES

Contractor shall provide control desk placed in FGD common control room, meeting specification requirements stipulated under sub section IIIC-09 Control Desk, Panels and Furniture PART-B, Section VI of technical specification.

The minimum quantity of furniture envisaged under this package is as mentioned below:

a) Chair-8 nos.

b) Printer table- 2 no

c) Computer table- 4 no.

d) Key pad- 2 no.

e) Locker set -2 no

Server rack, PC rack and workstation furniture shall be provided on as required basis.

14.00.00 SCOPE OF SERVICES

14.01.00 The Contractor or his sub-vendor(s) / associate(s) / engineering firm(s) shall have established engineering setup including skilled & experienced manpower, engineering software(s) and other required resources for carrying out basic and detailed engineering of control and instrumentation systems of FGD System. The Control and Instrumentation engineering shall include the following as a minimum.

a. Preparation of basic logic / loop diagrams (not just the implementation), I/O list, Drive list, instrument list etc for each of the plant areas of the complete plant including offsite systems based upon the flow schemes / write ups by the OEM's.

b. Engineering of power supply system for DDCMIS, Process connection and piping, Control valves etc.

c. Instrumentation, cable engineering including preparation of interconnection cable diagram, cable schedule etc.

d. The contractor shall deploy certified and experienced engineers in the system design of fieldbus during engineering and commissioning of fieldbus system. Further, the certified fieldbus engineers shall be available during commissioning of fieldbus instruments and actuators. Protocol will be signed with Employer's site engineer for successful commissioning of fieldbus instruments, actuator along with control system. The name(s) of such certified fieldbus commissioning engineer's shall be approved by Employer and for this the contractor shall submit CV/ experience details of proposed engineers.

Further, the contractor shall provide training to employer's personnel on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis. This training shall be provided by certified training agencies of foundation fieldbus/ Profibus foundation and it shall be provided before approval of basic design and engineering document.

The block logics shall be in the format as approved by Employer during detailed engineering stage.

For other services refer relevant sections of bidding documents.

15.00.00 Requirement for FGD control room and RIO room

FGD Control room and Remote I/O room (if applicable) shall be air conditioned and battery room shall be air ventilated. False ceiling shall be provided in Control room / RIO room.

The following guidelines shall be followed for control system cabinet placement in Control room / Remote I/O room:

i) Inter panel spacing- 1200 mm
ii) Clearance from back wall- 1200 mm
iii) Clearance from front wall- 1200mm
iv) Clearance from side wall- 1000mm

The above clearances are the minimum requirement and may increase with increase in door swing of cabinets.

Cable trench to be provided for FGD CR & Remote I/O Room. In case CR/ RIO Room is located above ground floor, cable vault shall be provided. False floor to route cables is not permitted.

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, geotechnical investigation etc. of all the facilities associated with complete Flue Gas Desulphurization system and its auxiliaries, 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 geotechnical investigation, earthwork in excavation, rock/concrete excavation by mechanical means & 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, pile load test, 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, storm water drains, separate drains and sump pit to collect contaminated water or effluents, 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, widening of 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 equipment, 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 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.

1.05.00 Cutting of trees including their disposal will be in the scope of Owner. Site levelling shall be done by Owner as per the levels specified in GLP in tender document. However, site clearance like removal of bushes, vegetation etc. and minor grading as required is in bidder's scope.

1.06.00. Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Double lane concrete road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided.

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. Land, if required, for developing temporary staff colony and labour colony along with fencing etc. 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. 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.

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 — One tapping from each unit (location depending on layout feasibility and subject to Employer's approval) from the Flue Gas Duct going towards the existing Chimney. No load of duct shall be transmitted on the Employer's facilities.
1.03.00	**Equipment Cooling Water**
1.03.01	**Normal and Emergency make up to ECW tank** Contractor shall take a tap off suitably from the existing DM make up pump suction header for meeting the makeup water requirement (maximum quantity 2m3/hr) of ECW system.
1.04.00	**Process Water** For process water requirement, Contractor shall take Clarified water tap off suitably from the CT make up pump discharge header in Miscellaneous Pump house area. The pressure available at the terminal point is 0.5 kg/m2.
1.05.00	**Gypsum Wash Water (Clarified Water)** For Gypsum washing, Contractor shall take Clarified water tap off suitably from the CT make up pump discharge header in Miscellaneous Pump house area for meeting the water requirement of 0.015 m3/hr/MW for Gypsum washing..
1.07.00	**Potable water** Contractor shall take a tap off suitably from the existing potable water supply header (potable water pump discharge) nearest to FGD area for meeting the potable water requirement.
1.08.00	**Waste Water** FGD waste water and LHP/GHP waste water shall be sent to ash slurry sump. Lime neutralization of FGD waste water shall be done before sending it to ash slurry sump. Bidder shall indicate the anticipated range of chloride content in the waste water at terminal point.
1.09.00	**Limestone** 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 7-8 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) Employer's HT switchgear
1.14.00	**Control & Instrumentation** a) Employer's marshalling cabinets/switchgear for hardwired signal exchange with Employer system. b) Employer's station wide LAN switch.
2.00.00	**EXCLUSIONS**
2.01.00	SG and BOP (C&I) DDCMIS
2.02.00	Station wide LAN

SUB-SECTION-V

SALIENT DESIGN DATA

1.00.00 The Flue Gas Desulphurisation (FGD) System for DCRTPP, Yamuna Nagar (2X300 MW) shall be designed with single absorber for both the units and 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)	2x300	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)	2x225	2x237
5	Gas flow at the FGD inlet when firing respective coal (Nm^3/sec)	2x322 (2x508 m^3/s)	2x350 (2x573 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)	5.604	5.414
	(ii) CO_2 (% v/v wet)	11.754	11.354
	(iii) H_2O (% v/v wet)	10.405	13.454
	(iv) SO_2 (% v/v wet)	0.065	0.063
	(v) N_2 (% v/v wet)	72.171	69.531
	(vi) Inlet SO_2 (mg/Nm^3-wet)	1856	1793
	(vii) Dust (mg/Nm^3)	80	200
	(viii) SO_3 (ppm)	10.5	10.2

Sl. No	Item	Guarantee Point	Design Point
	(ix) HCl (ppm)-wet	45	45
	(x) HF (ppm)-wet	12	12
8	SO_2 removal Efficiency (Continuous) (%) (min.)	94.04	94.04
9	Max. Limestone Consumption (kg/hr) for both the units with single absorber	7840	-
10	Max. Auxiliary Power Consumption (kW) for complete scope of work for both the units with single absorber	6600	-
11	Chimney Height (m)	Single Flue	150

NOTES:

1. The flue gas volume in Nm3/sec shall be calculated at 101.325 kPa and 273.15 K.

2. It shall be possible to reach the SO2 emission guarantees, at Guarantee point condition, with at least one spray level continuously out of service (in case the absorber is equipped with several spray levels) or one spare pump continuously out of service.

3. Pressure at Terminal Point before Booster Fan Suction shall be Zero (0) mmwc at Guarantee Point and Design Point Condition.

2.00.00	**Chimney**
2.01.01	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.
2.01.02	Single-flue or twin-flue chimney shall be provided away from the absorber tower. Chimney at the top of the absorber tower is not permitted. The flue gas emission point above the plant grade level shall be as per the salient design data as indicated in the previous clause.
2.01.03	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.
2.01.04	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 (ASTM B575, UNS N10276) alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done by explosion bonding or hot rolling to achieve the required quality as per ASTM B 898-11. Alternatively, Contractor can also provide chimney of 8 mm thick (minimum) mild steel with Borosilicate Glass Block Lining of minimum 38 mm thickness, which should have been in successful operation for similar application in at least two (2) units, located at different locations, for a period not less than two (2) years as on the date of Techno-Commercial bid opening. In such a case, Contractor/Lining supplier shall provide a ten (10) year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system. Transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint for Borosilicate Lining and insulated for Titanium/C276 cladding irrespective of surface temperature.
2.01.05	For Titanium/C-276 lining, the top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. For Borosilicate lining, the top flue liner above the roof slab shall be made of C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 8 mm thickness with Borosilicate Glass Block Lining of minimum 38 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner.
2.01.06	For Titanium/C-276 lining, external surface of chimney flue liner projecting over the

chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation.

For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 1/4th diameter of flue liner.

2.01.07 The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc.

2.01.08 The chimney liner & duct shall be designed & sized considering the following requirements as a minimum.

SN	Item	Chimney Sizing Condition
1	Boiler Load in MW (e)	TMCR Worst Coal (Guarantee Point)
2	Gas flow at Chimney Inlet (M^3/sec)	To be worked out considering Guarantee Point condition
3	Gas temperature at Chimney Inlet (deg. C)	To be worked out considering Guarantee Point conditions
4	Flue Gas velocity (m/s) inside Chimney	< 16.8 for Titanium / C-276 Lining < 18.3 for Borosilicate Lining

2.02.00 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

2.03.00 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.

3.00.00 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/sht	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.

3. For the purpose of sizing of equipment and guarantee, $MgCO_3$ shall be considered as unreactive dolomitic form.

4.00.00 **NOT USED**

5.00.00 **NOT USED**

6.00.00 **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.

6.01.00 **DESIGN PHILOSOPHY FOR AIR CONDITIONING**

1. Design ambient conditions for all air conditioning & ventilation system shall be as follows:

Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Summer	45	23
Monsoon	35.8	28.3
Winter	2	0

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 3Sq.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 like FGD control roomwhere load is more than 15TR, direct expansion (D-X) type condensing unit (with AHU) shall be provided. For other areas where air conditioning requirement is 5-15 TR ductable split/packaged A/C shall be provided. If the air conditioning load is less than 5TR, then Hi-wall Split/Cassette air conditioner shall be provided.
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.

6.02.00 **REDUNDANCY OF EQUIPMENTS**

6.02.01 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: 2 X 100%

b) 100% standby shall be provided for control rooms/RIO room/etc. served by ductable split/package type air conditioners.

At least one (1) no. unit, capacity same as each working unit as a common standby shall be provided for control rooms/RIO room/etc. served by non-ductable split (cassette / Hi-wall) type air conditioners.

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

6.03.00 **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 3deg.C below the design ambient temperature during summer for evaporative cooled areas.

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

Note: Dry bulb temperature during summer season shall be considered as Design Ambient Temperature for above.

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), etcshall 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 UAF 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.

7.00.00 Fire Detection and Protection System

7.01.00 **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.

7.02.00 **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 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.

v) Isolation valves (Gate Valves) shall be provided in each of the ring mains / sub-loops to enable to take up part of any of the ring mains for maintenance without any loss of system in the balance part.

vi) An isolation valve (Gate Valves) shall be provided in feeder & terminal pipes serving three or more hydrants or water monitors or in case the terminal length is 15 meters or more with a single/two hydrant valve. Each ring main shall be terminated with an isolation valve (Gate Valve) with a blind flange at all corners to enable future expansion/ modification by Employer.

vii) Hydrant risers in staircases shall be provided with isolation valves (Gate Valves).

7.03.00 **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.

viii) Material of construction for projectors / spray nozzles shall be Stainless Steel.

Pressure gauges and pressure switches at upstream and downstream of deluge valves shall be provided.

ix) An isolation valve (Gate Valve) with limit switch shall be provided at both upstream and downstream of each of the deluge valve. The size shall be same as that of the deluge valve.

7.04.00 **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.

8.00.00 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.

8.01.00 **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 as follows:-

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

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/cm2 (g).
4. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C.
5. Noise level shall not exceed 85 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.
6. Parallel operation of compressors shall be possible without any undue vibration and noise.
7. 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.
8. 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.

9.00.00 LIMESTONE AND GYPSUM HANDLING PLANTS

9.01.00 Refer Part-B section-I M6 of technical specification.

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

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.

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	**SO_2 Removal Efficiency** 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.	**INR 4,618,920/-** (INR Four Million Six Hundred Eighteen Thousand Nine Hundred Twenty 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)	**Limestone Consumption** For increase in the limestone consumption of FGD system in Kg/hr under conditions	**INR 18,354,962/-** (INR Eighteen Million Three Hundred Fifty Four Thousand Nine Hundred Sixty Two only) for every 100 kg/hr increase in Limestone consumption	(+)10% of the guaranteed limestone consumption.

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
	stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	from guaranteed value.	
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.	**INR 271,509/-** (INR Two Hundred Seventy One Thousand Five Hundred Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption

NOTES:

i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

ii) 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)

iii) 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.

iv) The LD values are applicable for the combined FGD system of both the units.

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) SO_2 removal Efficiency

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

(ii) Limestone Consumption

The Contractor shall guarantee that limestone consumption of FGD system in kg/hr shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00 Sub-section-V, Part-A of Section-VI).

(iii) Auxiliary Power Consumption

The Contractor shall guarantee that total auxiliary power consumption for complete scope of work for both the units with single common absorber, in normal operation shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00 Sub-section-V, Part-A of Section-VI applicable for complete scope of work), 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 Output fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh (for spray tower process)
(OR)
90% or higher (as per the requirement of the absorber) through 200 mesh (for bubbling process)

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 100 ppm and the moisture content shall not be more than 10% for guarantee point condition.

(vi) Waste Water

The Contractor shall guarantees that the maximum purge flow rate to waste water treatment system shall be not more than 12 m^3/hr for common system of both the units averaged over a 24 hour period.

(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:

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

ii) Pressure drop across air drying plant.

iii) 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) Limestone Handling System and Gypsum Handling System

a) Limestone Handling Plant

(i) The Bidder shall demonstrate the unloading at truck tippler, crushing and conveying to storage shed/silo and then reclaim from storage shed/silos and conveying to mill bunker at the guaranteed capacity including all intermediate equipment & conveyors.

(ii) Bidder shall also demonstrate the guaranteed tippling rate of truck tipplers.

b) Gypsum Handling Plant

The Bidder shall demonstrate the guaranteed conveying from belt filter to storage shed/silo including all intermediate equipment & conveyors.

5.00.00 AUXILIARY POWER CONSUMPTION

The auxiliary power consumption shall be calculated using the following relationship.

$P_a = P_u + T_L$

P_a = Guaranteed Auxiliary Power Consumption

Pu = Power consumed by the auxiliaries of the complete FGD system for both the units 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 Agitators

iv. Gypsum Bleed Pumps

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

vi. Limestone Slurry Pump(s)

vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries

viii. Power consumption of all working Booster water pumps (if provided) to ACW pumps after PHE

ix. Power consumption of Clarified water pumps (if provided) and Clarified booster water pumps (if provided)

x. Power consumption of Process water pump(s)

xi. Mist Eliminator Wash Water pump(s)

xii. Power consumption of Belt Filter Wash Water Pump

xiii. Power consumption of total number of DM Cooling (working) Water pump to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system

xiv. Power consumption of total number of Auxiliary Cooling (working) water pump to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system

xv. Booster Fans

xvi. Power consumption of Limestone Slurry Tank Agitator(s)

xvii. Power consumption of Filtrate Pump(s)

xviii. Power consumption of Cloth Wash Water Pump

xix. Power consumption of Hydro-cyclone and Waste Water Pump

xx. Power consumption of all other continuous running Agitators

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

xxii Total power consumption at motor input terminal at rated duty of fan of UAF(*)

(*) 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 UAF units and at an elevation of RL (referring to GLP of the project) for both AHUs and UAF centrifugal fans.)

xxiii Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable)

NOTE:

1. 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.
2. The bidder shall furnish a list of equipment to be covered under auxiliary power consumption, which shall be subject to Employer's approval.
3. Transformer losses (TL) shall be considered as per following (as applicable)- Aux/LT Outdoor/ LT Indoor Transformer: 100 % No load loss and 25 % of Copper Losses.
4. Auxiliary power shall be measured at the switchgear of the drives.

6.00.00 METHOD OF COMPUTING TEST EFFICIENCY OF FGD

The performance tests shall be carried out in accordance with ASME PTC 40 (2017) 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 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 200 mg/Nm^3 (dry basis at 6% O_2) in cleaned flue gas for the range of specified coals & loads

(iii) FGD may be required to be taken out of service as a result of the Employer's decision OR due to non-availability of items to be provided by the Employer (e.g. Limestone, Process water, power, etc.). In such instances, this duration will be considered as FGD operation time.

(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.

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

CLAUSE NO.	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 total population of each item for the project 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

Sl. No.	Description	Nos. / Sets
1.01.00	**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
1.03.00	**Not Used**	
1.04.00	**Absorber**	
	1. Absorber Spray/Oxidation nozzles	10% of each type and size
	2. Absorber Mist Eliminator Washing Nozzles	10% of each type and size
	3. 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	**Agitators**	
	(A) (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 hydrocyclone 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	**<u>Slurry Pumps</u>**	
	(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 assembly	1 no.
	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 **EQUIPMENT COOLING WATER SYSTEM**

A-1) Spares for horizontal pumps for ECW /Raw water system (for each type & size)

Name of Items	Unit	QTY
Impeller with nuts & other accessories	**Set**	**1**
Wearing rings (Impeller & Casing ; as applicable)	**Set**	**2**
Shaft	**Set**	**1**
Shaft Sleeves	**Set**	**2**
Pump & Drive Coupling, bushes, pins with all fasteners	**Set**	**1**
Pump bearings	**Set**	**1**
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- 2) Spares for Electrically operated hoist for FGD system for ECW system (for each type & size)

Name of Items	Unit	QTY.
Bearings	**Set**	**1**
Rope guide	**Set**	**1**
Brake lining	**Set**	**1**
Wire rope	**Set**	**1**

Note : One(1) set consists of quantity required for complete replacement for one(1) hoist of each type & capacity

A- 3) Spares for Plate type heat exchangers for ECW system (for each type & size)

Name of Items	Unit	QTY.
Gaskets	**Lot**	comprising 30% of total requirement
Fasteners	**Lot**	comprising 10% each type
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

1.20.00	**DELETED**		
1.21.00	**DELETED**		
1.22.00	**AIR CONDITINING AND VENTILATION 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

1.23.00 **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.
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	**GATE VALVES**	

	ITEM DESCRIPTION	QUANTITY
2.1	**Complete Valve**	
2.1.1	200 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.1.2	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.1.3	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.1.4	80 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.2	**Reduction Gear Operator for Gate Valve**	
2.2.1	200 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.3	**Gate (Gate Valve)**	
2.3.1	150 NB	5% or 1 No. of each type, class, size and model whichever is more.
2.3.2	250 NB	5% or 1 No. of each type, class, size and model whichever is more.
2.3.3	100 NB	5% or 1 No. of each type, class, size and model whichever is more.
2.3.4	80 NB	5% or 1 No. of each type, class, size and model whichever is more.
2.4	**Stem (all types), Seat ring (all types), Gaskets & Yoke Bush/Wedge Nut for Gate Valve**	
2.4.1	200 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.4.2	150 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.4.3	100 NB	10% or 1 No. of each type, class, size and model whichever is more.
2.4.4	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.
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**	

	ITEM DESCRIPTION	QUANTITY
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
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

	ITEM DESCRIPTION	QUANTITY
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.
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
7.5	**PLC CONTROL SYSTEM**	**Quantity**
7.5.1	Power Supply Unit	1 No. of each type and model,
7.5.2	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.
7.5.3	Central Processor Unit	1 No. of each type and model
7.5.4	Interconnecting Cables	10% of each type & size
7.5.5	Cooling Fan in PLC system / cabinet	2 Nos.
7.5.6	Indication lamps of all types	100%
7.5.7	Graphical Interface Unit	1 No.
7.6	**24V – DC POWER SUPPLY SYSTEM**	
7.6.1	CTs, CVTs, VTs, chokes, AC/DC isolators, contactors, timers, relays	5% or 2 Nos. of each type and rating whichever is more.

	ITEM DESCRIPTION	QUANTITY
7.6.2	Fuses of each type and rating	200%
7.6.3	Fuse free Circuit breakers	5% or 5 Nos. of each type and rating whichever is more.
7.6.4	Electronic modules of all types	One No. of each type
7.6.5	Indication lamps	100%
7.6.6	Cooling Fans	1 No. of each type
7.6.7	Indicators	1 No of each type and rating
7.6.8	Relays of all types including overload relays	2 Nos. of each type and rating
7.6.9	Batteries	5% or 2 nos. of each type & rating whichever is more

1.24.00 **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 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

	ITEM DESCRIPTION	QUANTITY
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
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

	ITEM DESCRIPTION	QUANTITY
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 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.

1.25.00 **LIMESTONE & GYPSUM HANDLING**

S.N.	If Applicable (Y/N)	ITEM	QTY	Unit
1		**Mechanical**		
A)		**Surface Feeder/ Box Feeder/ Truck Unloading System**		Drawing/ Catalog required for identifying parts
	i)	Head shaft	one	no
	ii)	Tail shaft	one	no
	iii)	Chain	one length	no
	Iv)	Flight Bars	one	Set
	v)	Keeper Plates	one	Set
	vi	Side Liners	one	set
	vii	Gearbox	one	No each type
	viii	Coupling	one	No each type
	viii	Bearings	one	No each type
	ix	Oil seals	one	No each type
		TRUCK TIPPLER		
	x	Hydraulic Cylinder:	one	no of each type
	xi	Hydraulic Hoses	one	no of each type
	xii	Hydraulic Pump	one	no of each type
	xiii	Hydraulic Clamp	one	no of each type
	xiv	Seal Kit	one	no of each type
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
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
13		Guide Rollers for bucket elevator	30%	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.
			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 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	one	complete length of each type
	iii)	Bucket elevator	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
	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 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)	1	Set
	ii)	Shaft seal	2	sets
	iii)	Hammer sets (consisting of hammer arm, hammer head, bush for arm etc)	4	sets
	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 blocks	1	set
	v)	Cage bars/Perforated screen plates as applicable	2	sets
	vi)	Breaker plate	2	sets
	vii)	Liners	2	sets
	viii)	Suspension bars	2	set
	ix)	Kick-off plate	2	set
	x)	Screen plate upper & lower	2	no. each

	xi)	Tramp iron pick up plate	1	no. each
	xii)	Fluid coupling		
	xiii)	Fluid coupling complete	1	set
	xiv)	Bearings	2	sets
	xv)	Seal kit	2	sets
	xvi)	Fusible plugs	4	nos.
	xvii)	Oil pump motor set	1	set of each type
	xviii)	Oil filter	3	sets
	xix)	Complete actuator and engaging assembly (including motor, gear box etc.)	1	set
	xx)	Cooler assembly	1	no.
	xxi)	Oil / Water valves	1	nos. of each type
	xxii)	Gear Coupling/ other flexible coupling of crusher drive along with bolts and sealing kit, as applicable	1	sets
	xxiii)	Multi Disc assembly (for fluid coupling)	1	sets. of each type and rating
	xxiv)	Resilient Drive plate assy	1	sets. of each type and rating
J)		**VIBRATING FEEDER AND VIBRATING SCREEN FEEDER**		MS to be provided for VF and VSF seperately
	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 MOBILE TRIPPERS)**		
	i)	Limit switch	8	nos. of each type & rating
	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
	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)		**BUCKET ELEVATOR**		
	1	Buckets	10	% of total population
	2	Linkages/ Fixing arrangement of buckets on belt	20	% of total population
Q)		**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
	4	Pulley	2	nos of each type
	5	Belts	2	sets of each size
	6	Impeller and shaft of coal slury	1	set of each type

		disposal pump		
	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
R)		**MOBILE 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
S)		**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 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
T)		**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
U)		**ROTARY FEEDER**		
	i)	Rotating Assembly	1	No.
	ii)	Bearings	1	No. each type
	iii)	Bearing Housing	1	Set

	iv)	Chain and Sprockets	1	Set
	v)	Gearbox	1	Set

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

1.26.00 **CONTROL AND INSTRUMENTATION**

(EXCLUDING AIR CONDITIONING AND VENTILATION SYSTEM, COMPRESSED AIR SYSTEM, FIRE DETECTION AND PROTECTION SYSTEM. For mandatory spare of these systems, refer mandatory spare clauses specified under respective systems)

1.00.00	**CONTROL AND INSTRUMENTATION**	
1.01.00	**MEASURING INSTRUMENTS**	
1.01.01	(i) Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also.	10% or 1 no. of each type and model, whichever is more.
	(ii) Density meter	10% or 1 no. of each type and model, whichever is more.

1.01.02	Temp Elements along with thermo well (except winding temp elements of motor)	10% or 2 no. of each type, model & length, whichever is more.
1.01.03	(i) Process Actuated Switches (Pressure, Differential pressure, flow, level, temp)	10% or 2 no. of each type and model, whichever is more.
	(ii) Limit switches (for pneumatic and manual valves)	10% or 2 no. of each type and model, whichever is more.
1.01.04	Local Gauges for Pressure, Differential pressure, flow, level, temp	5% or 1 no. of each type, model and range, whichever is more.
1.01.05	Vibration monitoring system	
(i)	Sensors	10% or Minimum 2 Nos. of each type, make and model whichever is more. *if prefab cable or prefab extension cable is used same should be supplied in proportion.
(ii)	Power Supply Module Cards	10% or minimum 2 nos which ever is more
(iii)	Driver / Interface Cards & all other electronic cards.	10% or minimum 2 nos which ever is more
1.02.00	**Continuous Emission Monitoring System (CEMS)**	
(i)	Analyzer for SO2, NOx, CO2, CO.	1 no. complete analyser of each type and model.
(ii)	Flue gas flow measurement instrument	1 no. complete instrument along with sender/receiver unit.
(iii)	Analyser for Particulate Matter	1 no. complete analyser

(iv)	Analyser for Mercury	1 no. complete analyser
(v)	O2 Analyser	1 no. complete analyser
(vi)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating
(vii)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(viii)	Temp. Sensor	20% of each type and model
(ix)	Heater assembly, Coolers/dryers, Pumps, etc..	20% of each type and model
(x)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model
(xi)	Solenoids	2 nos. of each type, model and rating
(xii)	Filters, light source, sensor, detector, etc.	100% of each type, model and rating
(xiii)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply
(xiv)	Blower assembly	1 no. of each type, size and rating.
1.03.00	**Other FGD Analysers**	
(i)	Analysers for SO2, pH	1 no. complete analyser of each type and model.
(ii)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(iii)	Heater assembly, Coolers/dryers, pumps	20% of each type and model
(iv)	Filters, light source, sensor, detector, etc.	100% of each type, model and rating
(v)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model
(vi)	Solenoids	2 nos. of each type, model and rating

(vii)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating
(viii)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply

1.04.00 **NOT USED**

1.05.00 **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.

1.06.00 **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
1.07.00	**24V – DC POWER SUPPLY SYSTEM**	
1.07.01	AC/DC isolators, contactors, timers, relays	10% of each type and rating.
1.07.02	Fuses of each type and rating	200%
1.07.03	Fuse free Circuit breakers	5% of each type and rating.
1.07.04	Electronic modules of all types	10% of each type.
1.07.05	Cooling Fans	2 nos. of each type
1.07.06	Relays of all types including overload relays	10% of each type and rating

1.08.00 DISTRIBUTED DIGITAL CONTROL MONITORING AND INFORMATION SYSTEM (DDCMIS)

Sl No	ITEM	QUANTITY
1.	**HMI Devices**	
A)	**Work station/PC station/servers**	
	(i) OWS with licensed software	2 nos. of each type and model
	(ii) Server/Information Workstation with licensed software (as applicable)	1 no. of each type and model
	(iii) Programmer cum documentation station along with licensed software	1 no. of each type and model
	(iv) Keyboard	2 nos. of each type and model
	(v) Mouse	4 nos. of each type and model
B)	**Printers**	
	(i) Color laser printer (A4)	1 no
	(ii) Print head assembly for A4 color laser printer	2 nos of each type and model

C)	**Network Components**	
	(i) Switch/repeaters/hubs/firewalls for DDCMIS	2 nos. of each type and model
	(ii) Wireless equipment like power supplies ,modems, electronic modules, media converter(if applicable),connectors patch card, antenna etc.	2 nos. of each type and model
	(iii) Any other device/equipment not covered under above items but required to make system complete.	2 nos. of each type and model
D)	**Miscellaneous items**	
	(i) Hard disk drive unit of each type as offered in main offer complete with disks and other accessories	4 nos. (to be divided based on main population)
	(ii) Bulk Storage drive unit	2 nos. of each type and model
	(iii) Graphic processors modules/Card for work station/server	2 nos. of each type and model
(E)	Any other device/items for HMIPIS system which are not covered in above items but are required to make the system complete.	1 no of each type and model
2.	**Cables and Connectors.**	
	(i)Prefab interconnecting cables with connectors	2 no. of each type and length.
	(ii)System bus cable with connectors	2 no. of each type and length.
	(iii)I/O bus cable with connectors for remote I/O units	2 no. of each type and length.
	(iv)Loose Connectors	5 nos. (sets) of each type

	3.	Power Supply Modules & Power Packs for control system	20% or 4 nos. of each type model and rating, whichever is more.
	4.	Electronic modules of each type and model for control system, Data communication system etc. (This shall include all type of cards like I/O cards, Remote I/O cards, communication/Interface cards, controller cards, CPU module or Card, logic cards, etc.)	20% or 2 Nos of each type, model and rating whichever is more subject to maximum of 20 Nos of each type.
	5.	Bus coupler/Interface hardware / other communication devices.	20% of each type and model or minimum 2 nos. whichever is more.
	6.	Relays	10% of each type and model or minimum 2 nos which ever is more
	7.	Batteries used for battery backup of RAMs(If applicable)	10% of each type and model or minimum 2 nos whichever is more
	8.	Fuses	200 % of each type and rating
	9.	Cooling fans for Power supply and cabinets.	10 % of each type and model
	10	Intelligent mini UPS for workstation server, PCs, L3 switch.	1 no. of each size and rating
	11	For all items of Fieldbus system (including field accessories) except fieldbus cables	20% or 2 Nos. of each type, model and rating whichever is more subject to maximum of 40 Nos of each type.
	12	Fieldbus cable	10% of total length used in the project.
	1.09.00	**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	10% or 2 nos. whichever is more.

applicable)

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.

1.10.00 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

1.11.00 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

1.12.00 ELECTRIC ACTUATORS

1	Actuators	1 no of each type and rating
2	Electronic PCB of all types	10% of each type & model
3	Absolute Encoder (replaceable part)	5% of each type & model
4	Electronic Torque sensor	5% of each type & model

1.13.00 Uninterrupted Power supply (UPS) including Static Switch

Sl No	ITEM	QUANTITY
(i)	Silicon controlled thyristors, diodes and power transistors.	100 %
(ii)	Capacitors	1 set
(iii)	CT's, CVT's VT's chokes, AC/DC isolators, contactors, timers, relays	10% of each type and rating.
(iv)	Fuses of each types and rating	200%
(v)	Fuse free Circuit breakers	5% of each type and rating
(vi)	Electronic modules	10% of each type
(vii)	Indication lamps	100% of each type
(viii)	Lamp holders with series	10% of each type

		resistor, if any	
	(ix)	Cooling Fans	2 nos. of each type
	(x)	Digital/analog panel meters/ indicators	1 no. of each type
	(xi)	Relays of all types including overload relays.	10%
	(xii)	Static Switch	10% or minimum 1 no (whichever is higher) of each type and rating

1.27.00 **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	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) & 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 three 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 LIGHTING

1.	LED Fixture	5 nos of each type and rating
2.	Lighting Panels: Timer 24 hrs	5 nos

3.	Lighting Control switch/ Receptacles:	
	a) 20A receptacles with plug	5 nos
	b) 20A rotary switch	5 nos
4.	Junction Boxes: Type F-2 Terminal Strips	25 nos

1.03.00 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 (if applicable)	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 & rating
8	Potential transformer of each type & ratio	3 Nos. of each type & rating
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

1.04.00 DC SYSTEM

S.NO.	**ITEM DESCRIPTION**	**QUANTITY (of offered type)**
1.0	**BATTERY**	
1.1	Complete dry cell	5 Nos.

1.2	Intercell connectors with Hardware	5 Nos.
1.3	Vent Plug	5 Nos.
1.4	Electrolyte Level indicating float (For opaque containers only)	5 Nos.
1.5	Stand Insulator (if applicable)	5 Nos.
1.6	Cell Insulator	5 Nos.
2.0	**Battery Charger (Float cum Boost)**	
2.1	Set of Electronic Cards/ Module	1 set of each type & rating
2.2	Set of Auxiliary relays	1 set of each type & rating
2.3	Set of Fuse Links and Glass Fuses	3 sets of each type and rating
2.4	Set of SCR and Diode	3 sets of each type and rating
2.5	Rectifier Transformer	1 no of each type & rating
2.6	Control Transformers	1 no of each type & rating

i.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

I. List of Mandatory spares for Dry Type Transformers

S. N.	Components	Qty (each/type)
1	HV Bushing (if applicable)	1 No.
2	LV Bushing (if applicable)	1 No.
3	LV Neutral Bushing (if applicable)	1 No.
4	Complete Winding Limb(HV and LV)	1 No. each
5	WTI (if applicable)	1 No.
6	Set of Thermister /RTD with associated leads complete for one transformer	1 Set

Note: 1 set consists of quantities required for 1 complete transformer.

II. Mandatory spares for oil filled outdoor transformers

S.N.	Components	Qty (each/type)
1.	HV Bushing with metal parts and gaskets	3
2.	LV bushing with metal parts and gaskets	3
3.	LV Neutral bushing with metal parts and gaskets	1
4.	WTI with contacts	1
5.	OTI with contacts	1
6.	Pressure relief device	1
7.	MOG	1
8.	Buchholz relay complete	1
9.	Set of gaskets	1 Set
10.	Set of valves	1 Set

Note: 1 set consists of quantities required for 1 complete transformer.

III. Mandatory spares for FGD Tie transformers

S.No.	ITEMS DESCRIPTION	FGD TIE TRANSFORMER
1.	HV Bushing with metal parts and gaskets (nos.)	2*

2.	HV Neutral bushing with metal parts and gaskets(nos.)	1
3.	MV bushing with metal parts and gaskets(nos.)	-
4.	LV bushing with metal parts and gaskets(nos.)	3
5.	LV Neutral bushing with metal parts and gaskets(no.)	1
6.	WTI with contacts(no.)	1
7.	OTI with contacts(no.)	1
8.	Pressure relief device(no.)	1
9.	MOG(no.)	1
10.	Buchholz relay complete(no.)	1
11.	Set of gaskets	1 Set
12.	Set of valves	1 Set
13.	Cooler fan with motor (nos.)	2
14.	Oil Pump with motor(nos.)	-
15.	Oil flow meter(nos.)	-
16.	Set of On load/Off Circuit Tap changer contacts	1 (OLTC)
17.	Air cell for conservator(no.)	1
18.	Neutral Grounding Resistor w/o supporting structure (11 kV, 11.07 ohms, 600A for 10sec.)	2 Nos.
19.	Neutral Grounding Resistor w/o supporting structure (3.3 kV, 3.32 ohms, 600A for 10sec.)	2 Nos.

* (with stand for vertical storage)
Note: 1 set consists of quantities required for 1 complete transformer.

1.07.00 VFD

A. VFD TRANSFORMER (If applicable)

1	Primary Bushings with metal parts and gaskets(if applicable)	1 no. each rating
2	Secondary Bushings with metal parts and gaskets	1 no. each rating
3	Winding temperature indicator with alarm & trip contacts	1 no.
4	Oil temperature indicator with alarm & trip contacts	1 no.
5	Magnetic oil level gauge	1 no.
6	Pressure relief device	1 no.
7	Diaphragm for explosion vent	1 no.
8	Buchholz relay/sudden pressure relay	1 no.
9	Silca gel charge	1 no.
10	Pressure gauge (applicable for sealed tank)	1 no. each type

B. VFD SYSTEM :

1	Electronic cards	
	(a) Control modules	1 nos. of each type & rating
	(b) I/O module	1 nos. of each type & rating
	(c) Power supply modules	1 nos. of each type & rating
	(d) Gate module including gate transformer	100% of one channel
2	Power device (Thyristor, IGBT etc.) bridge leg	1no.(Qty. for one ph.)
3	Over voltage limiter and surge suppressor network	1 set
4	Semi conductor fuses for Power device (thyristor, IGBT etc.)	1 set
5	Power & Control fuse	25% of installed quantity
6	Control Transformer	1 nos. of each type & rating
7	Contactor/Breaker	1 no.
8	CT/VT	1 nos. of each type & rating
9	Indicating lamps	100% of each type & rating
10	Auxiliary contactors & relays	1 no. of each type & rating
12	Indicating lamp holder full set	15% of each type and colour

13	Panel mounted meters	1 no. of each type & rating

1.08.00 DIESEL GENERATOR SET

1(a)	Ammeter (as Used in Main Equipment)	1 No.
1(b)	Voltmeter (as Used in Main Equipment)	1 No.
2	Gaskets & packing	1 set
3	Valve springs	1 set
4	Fuel pump complete	1 set
5	Fuel nozzles and needles	1 set
6	Piston, complete with rings and rod	1 set
7	Piston rings(for each engine)	1 set
8	Flow and temperature relay of each type used	1 set
9	Main and end bearing shells for the diesel engine	1 set
10	Generator bearing sheets	1 No.
11	Rotor pole coil	1 No.
12	Battery charging rectifier diodes	4 No.
13	Complete rotor rectifier assembly for alternator	1 set
14	Fuses for the excitation diodes	3 sets
15	Automatic Voltage regulator	1 set
16	Solenoid coil for each solenoid operated valve or relay used	2 each
17	Instrument and indicator of each type used	1 each
18	Alarm and signal lamps of each type used	10% of total population
19	Cabinet lighting lamps(if applicable)	2 each
20	Shut down coil	1 No.

21	Lub oil pressure relay	1 No.
22	Filter screen	1 No.
23	'O' rings injector	1 set
24	'O' rings breather	1 set
25	Magnetic Pick up	1 No.
26	Actuator	1 set
27	Air cleaner	1 set
30	Belts(Fan belt)	1 set
31	Hose bypass	1 No.
32	Hose turbo oil supply	2 Nos.
33	Hose turbo oil drain	2 Nos.
34	Turbo repair kit	1 No.
35	Over speed stop	1 No.
36	Resistor for diesel generator	48 Nos.
37	Element lube oil filter for Diesel Engine	48 Nos.
38	Element lube oil by-pass filter for Diesel Engine	24 Nos.
39	Element fuel filter for Diesel Engine	24 Nos.
40	Plate corr. Resistor for Diesel Engine	96 Nos.
41	Element air cleaner for Diesel Engine	4 Nos.
42	Diodes forward for alternator	3 Nos.
43	Diodes reverse for alternator	3 Nos.
44	HRC fuses links of various rating	3 Nos. of each type
45	Ammeter selector switches	1 No.
46	Local/Remote selector switches	1 No.
47	Voltmeter selector switches	1 No.
48	Push button for trip circuit healthy test	1 No.

49	White indication lamps for spring charged position	1 No.
50	Alarm bell	1 No.
51	Space heater along with control switch	1 No.
52	Trip circuit supervision relay	1 No.
53	Lube oil pump assembly/ rotating assembly/ impeller/shaft	1 set
54	Starting air motor	1 No.
55	Governing mechanism of DG set	1 No.

1.09.00 400KV SWITCHYARD (IF APPLICABLE)

S.NO.	ITEM DESCRIPTION	QTY (of offered type)
I.	**CIRCUIT BREAKERS**	
1	One Complete breaker, 3 Poles along with drive unit, marshalling box & terminal connectors	1 no.
2	Tripping and closing coil (one set consisting of one no. each of all types)	3 sets
3	Spring charging motors (if applicable)	1 no.
4	SF6 Gas filling Valve (DILO)	1 no.
5	SF6 gas	3 Cylinders
II.	**ISOLATORS**	
1	One complete pole of HCB isolator with 2 E/S along with operating mechanisms, etc.(without Structure)	1no
III	**CURRENT TRANSFORMER** complete in all respects including terminal connectors.	1 no.
V	**SURGE ARRESTER** complete in all respects including terminal connector and with surge counter and lead.	1 no.
VI	String insulator & hardware, clamp connectors, spacers and Corona bells	10% of total quantity of each type and rating

1.10.00 CONTROL AND PROTECTION (IF APPLICABLE)

S.NO.	DESCRIPTION	QUANTITY
1.	Bay Control unit (complete with all components)	1 Nos.
2.	Numerical Relays comprising various bay protection units, Bus Bar and Islanding Scheme	1 No. of each type
3.	Energy Meter	1 no. of each type
4.	Operator work station (OWS) along with software, monitor, mouse, keyboard, printer etc.	1 No.
5.	Media cleaning solution	2 bottles
6.	Fuses	100% of each type and rating
7.	Terminal Blocks	5 nos. of each type, make, model and rating
8.	Interface cables containing standard length of each type of cable and its connector for each type of peripheral	2 Sets
9.	MCBs	50% of each type, make and model used in the system
10.	Relays other than numerical relays	10% of each type of total population (min 1 no.)

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.

1.28.00 **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