TECHNICAL SPECIFICATION
FOR
LIMESTONE HANDLING SYSTEM
VOLUME- II B & III

SPECIFICATION NO. PE-TS-STD-170-A001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA
1.0 SCOPE

1.1. This specification covers design, engineering, manufacture, shop fabrication, assembly, testing and inspection at manufacturer's work, type testing wherever applicable, packing, ocean shipment, marine insurance, custom clearance, port clearance and handling, inland transportation, delivery at site, civil & structural works, unloading, handling, storage and in plant transportation at site, complete services of erection including erection supervision and site testing, inspection, storage, erection and commissioning, trial run, performance testing and handing over to the Owner, of complete Limestone Handling System.

1.2. It is not the intent to specify completely herein all details of design and construction of equipment. However, all the equipments shall conform in all respect to high standards of engineering, design, workmanship and be capable of performing in continuous commercial operation throughout the life of the plant.

1.3. The equipment and materials to be supplied by the Contractor shall form a fully comprehensive Limestone Handling system. The equipment and services as detailed in all sections of the specification. Any items though not specifically mentioned but which are required to make the plant complete in all respects for its safe, efficient, and reliable and trouble free operation shall also be taken to be included, and the same shall be supplied and erected by the Contractor, unless they are specifically excluded.

1.4. The general terms and conditions, instructions to bidder and other attachments referred to elsewhere are made a part of the tender specification. The equipment, materials and works covered by this specification are subject to all the attachments referred in the specification. The bidder shall be responsible for and governed by all the requirements stipulated hereinafter.

1.5. No deviation is permitted in normal case. Deviation if any shall be clearly brought out, otherwise it will be presumed that the bidder's offer is in line with what has been stated/asked in this NIT specification.

1.6. In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply and same shall be adhered and provided by the bidder during detail engineering stage without any commercial implication.
1.00.00 **SCOPE OF WORK**

1.01.00 This specification covers design & engineering, manufacture, inspection and testing at vendor's/sub vendor's works, dispatch including freight, storage and handling at site, civil and structural works, painting/ coating, erection and commissioning, trail run and performance guarantee test at site for complete Limestone Handling System. Detailed scope of work and equipment details shall be as indicated below and also as indicated in different sections of this specification.

1.02.00 **EQUIPMENT & SERVICES TO BE PROVIDED BY VENDOR**

Equipment and services to be provided by the vendors shall be as per different sections of this specification and shall be complete in all respect considering following exclusions.

1.03.00 **EQUIPMENT & SERVICES TO BE PROVIDED BY CUSTOMER/PURCHASER**

1.03.01 **Civil** - 1000 MT Limestone Bunker(s) – 3 nos. with bunker supporting structure and its foundation and shed.

1.03.02 **Mechanical** - Air conditioning, ventilation and fire fighting facilities required for various buildings of powdered limestone handling plant as required. Bidder shall provide necessary opening for installation of above.

1.04.0 **LIMESTONE HANDLING, MILLING AND CONVEYING CAPACITY**

System capacity for following

a) Handling System (Belt Conveying system) : up to 400 TPH
b) Milling System : up to 80 TPH
c) Pneumatic Conveying system : up to 100 TPH

Capacities are vary from project to project

1.05.00 **SCOPE OF SUPPLY**

- The scope of work comprises turnkey supply, erection and commissioning of complete mechanical, electrical, C&I and associated civil, structural and architectural works of limestone handling system as specified and defined in this specification.

- The equipment and materials to be supplied by the Contractor shall form a fully integrated & comprehensive powdered limestone handling system. The equipment and services as detailed in all sections of the bidding documents shall be in bidder’s scope. Any items though not specifically mentioned but which are required to make the plant complete in all respects for its safe, efficient and reliable and trouble free operation shall also be taken to be included, and the same shall be supplied and erected by the Contractor, unless they are specifically excluded.

Notwithstanding the scope mentioned for various sub-systems in the following paragraphs, it is the responsibility of the contractor to carry out complete job on turnkey basis and integrate the sub-systems with each other.

**Limestone handling, milling, conveying & feeding System: System description:**

1. The system includes the following sub-systems:
a. Raw limestone belt conveying system from reclaim hopper to limestone bunker with crushing arrangement
b. Feeding arrangement from Limestone Feed bunker to Mill.
c. Powdered lime stone conveying system from mill outlet up to product hopper.
d. Powdered limestone conveying system from the outlet of product hopper up to powder limestone bunker near boiler.

2. Raw limestone belt conveying system from reclaim hopper to limestone bunker with crushing arrangement
Limestone handling system includes conveying, reclaiming, crushing, screening, and bunker feeding system. All the auxiliary systems like bunker ventilation systems, Industrial Vacuum Cleaning System in buildings like limestone crusher house etc., conveyor weigh scales, metal detectors, sampling system for limestone. The limestone handling system shall be generally as per the system description, flow diagram, and layout etc. enclosed. The system shall be complete in all respects with all mechanical, civil, structural, and electrical and instrumentation. Limestone handling system (LSHS) and associated accessories

a) Limestone of (−) 150 mm size would be received by trucks/dumpers and pile would be formed. The limestone would then be dozed into both the proposed limestone reclaim hoppers No. RH-LS-A and RH-LS-B. The limestone dozed into the hoppers shall be conveyed to the screen cum crusher house through the proposed belt conveyor No. BCN-LS-1, belt feeders No. BFD-LS-1 & 2 and associated equipment like rack & pinion gates and rod gates. In the vibrating screens No. SCR-LS-1A/B located in the limestone screen cum crusher house, limestone of (+) 25 mm size shall be retained and limestone of (−) 25 mm size shall be separated. (+) 25 mm size limestone retained by the vibrating screens shall be fed to the respective proposed crushers No. CRS-LS-1A or 1B.

b) The (−) 25 mm size limestone separated by the vibrating screens and from the crushers shall be fed to the proposed belt conveyor No. BCN-LS-2 fitted with travelling tripper No. TTR-LS-1. Belt conveyor No. BCN-LS-2 fitted with travelling trippers TTR-LS-1 shall feed limestone to the limestone bunkers of the Units No. 1 & 2. The feeding of last bunker shall be done from head end of conveyor BCN-LS-2. 02 Nos. of radar type level transmitter shall be provided for each raw limestone bunker. Active load cells shall be provided for each limestone raw bunker for weight measurements. Tunnel ventilation system for the tunnel of belt conveyor No. BCN-LS-1 of LSHS

b) Tramp iron separation and non-ferrous metal detection: Tramp iron shall be separated by inline magnetic separator at the location shown in the flow diagram. The tramp iron picked up by the inline magnetic separator shall be discharged outside the junction tower where the inline magnetic separator is located through tramp iron chute. Similarly, ferrous and non-ferrous metals shall be detected by metal detector located at location shown in the flow diagram. The metal detector shall identify the ferrous and non-ferrous metals and trip the respective conveyor on which it is located. Inline conveyor scale

b) Inline conveyor scale shall be provided on conveyor No. BCN-LS-1 at the location is shown in the flow diagram to continuously measure the rate of conveying on this conveyor.

d) Rated Capacity of LSHS: The rated capacity of all the LSHS equipment shall be 400 TPH with a bulk density of 1.2 T/Cum.

e) Duty of LSHS: Normally, the LSHS shall operate for about 12 hours in a day to fill up the limestone bunkers to meet the limestone requirements of the Units. However, if it becomes necessary to run the system for 24 hours, it shall be possible to operate continuously for any period.

3. A milling system (3 mills = 2 Working + 1 common standby for both units) shall be selected by the bidder based on the lime stone properties indicated in ‘Annexure to data sheet-A’. The crushed limestone shall be
fed to grinding mill through a weigh feeder. In the mill, limestone of 90% (-) 25mm, 10% up to 40 mm shall be powdered to less than (-) 1 mm size.

4. Grit separator shall be provided to separate the coarse limestone particles from the pulverised limestone and return the same to the mill body through the grit screw conveyor. The fineness controller vanes shall be connected to one another and shall be controlled/adjusted simultaneously by a servomotor while mill is in operation.

5. The mills shall operate under negative pressure. Hence, a special sealing joint between the fixed part and the rotating part shall be provided to prevent limestone dust escaping out into the atmosphere.

6. Lubrication for Mill Bearing and Mill Gear Boxes: Lube Oil System shall be supplied with Supply & Return Lines and necessary accessories like Pumps, Valves, Strainers, Filters, PHE, Lube oil Tank etc. Piping fittings for HFO/LPG skids, Instrument air line, Lube oil/ Gear oil or any other Oil system shall be from reputed make.

7. Lube Oil System shall be skid mounted with canopy. All accessories shall be supplied from approved (approved by owners) vendors.

8. Grease spray system for Girth Gear: Bidder shall supply complete system with Pump, Piping with SS hose, Valves, Reservoir Tank and all accessories required for measuring and control. System shall be skid mounted with canopy.

9. The instrument air requirements for control of this system shall be provided by dedicated instrument air system consisting of 2 x 100% capacity (Screw type air Compressors in Lime stone compressor House required near lime stone mill building.) The instrument air quality shall be such to have a dew point -40degC at discharge.

10. **Powdered limestone milling system starts from the limestone bunker outlet flange to the product hopper inlet, consisting of:**

11. This system shall consist of cyclone separator, Grit Separator, automatic reverse pulse jet type bag filter, rotary vane feeders below cyclone and bag filter, ID fan & product collecting hopper, Hot air from HFO fired hot air generators shall be provided along with the raw lime stone to mill. Each hot air generator and ducts shall be sized to feed the requirement of one mill at a time. The above mentioned ID fan is required to create the necessary Draft to transport the grounded lime stone from mill to product hopper. Two sets of fluidizing pads to be provided in product hopper at all four sides.

12. **HFO Handling & Firing System for each mill**

13. System shall consist of Oil storage tank, 2 x 100% HFO pressuring pump, individual strainers & isolation valves before and after pumps, Electric Heaters, HFO pressure control valve in discharge of oil pumps with return line connected to tank. All HFO lines shall have electric tracing.

14. HFO flow control valves shall be provided for controlling HFO flow to burner. Coriolis type mass flow meters shall be provided for HFO flow measurement. In the HFO lines to burner, (after FCV), for the purpose of quick fuel cut off, two pneumatically operated trip Valves (normally close) with one pneumatically operated drain valve (normally open) to drain tank shall be provided.

16. Atomizing air system shall be provided with necessary DP control valve, piping & necessary valves. Scavenging and trip valves shall be pneumatically operated.
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17. The LPG system for pilot flame shall be provided with two (2) trip valves (NC type) and one (1) vent valve (NO type) connected up to a suitable vent location. These valves may be pneumatically operated or direct SOVs.

18. The control system for the burners shall conform BMS-Compliance to NFPA Guidelines i.e. Availability, protected configuration change, Independent hot-redundant CPU (redundancy in CPU, communication & power supply), Fault Tolerance and Support hardwired Backup tripping.

19. The operation, monitoring and control of the burner shall be from the HMI (operator station) located in the control room.

20. The HFO pumping system, HFO heating system, HFO/atomizing/LPG control stations etc. shall be delivered in the form of skids (for fast erection at site). These prefabricated skids with terminal points shall be complete with internal piping, impulse tubing, wiring, supports, valves, instrumentation, etc. The skids shall be dispatched taking care of the following:

   a. All measuring instruments shall be mounted in the skid complete with impulse tubing (1/2" SS tubing and fittings of Swagelok only) to transmitters/gauges/etc.

   b. Instrument air header shall be provided in the respective skid complete with impulse up to all pneumatic valves (1/4" SS tubing and fittings of Swagelok only).

   c. All wiring from instruments, SOVs, pneumatic valves etc. shall be pre-wired up to a local Junction Box in the skid.

   d. The make of all skid items/components shall be as per approved vendor list only. The skid drawings shall be subject to approval during detail engineering.

Canopy and protective structure to prevent damage during Transit, handling and installation shall be provided.

21. The control valves shall be pneumatic type provided with E to P HART-SMART positioners with integral 4-20mA position transmitter & proximity switches for open / close position feedbacks.

22. The pneumatically operated on-off valves shall be provided with proximity switches for open / close position feedbacks.

23. For all proximity switches for position feedback applications proximity switch isolating amplifier shall be provided in the marshalling panel of control system for potential free contacts.

24. For HFO applications glycerine seal pots shall be provided for press gauges, press transmitters, DP transmitters, press switch, DPS etc.

25. For proper combustion monitoring, continuous duty O₂ analyzer for burner hot discharge gases shall be provided with 4-20mA signal to the control system. O₂ analyzer shall be of suitable type for the burner type and shall be of approved make only.

26, 27 & 28 - VOID

29. **Powdered lime stone conveying system from the outlet of product hopper up to powdered lime stone bunker near boiler:**
30. The transportation system for conveying of powdered lime stone from the product hoppers to the powdered lime stone bunker in Steam Generator area shall be of pneumatic type and the velocity of air and powdered limestone mixture shall not exceed 10 m/s. Phase density shall be minimum 35. The dry air required for transporting the powdered limestone shall be by dedicated Screw Compressor.

31. All the bends in the pneumatic Conveying system shall be provided with cast basalt lining. High and low level probes shall be provided in the product hopper. The low level probe shall be utilized for initiation of the start of the feeding system and the high level probe shall be utilized for prevention of flooding during the time powdered lime stone handling system is not available.

33. Vent valves shall be provided above the highest powdered limestone level in the product hopper.

34. The conveying air system shall consist of 3 X 100% conveying air Screw type Compressor. Provision shall be made for Lime powder conveying line shall be interconnected in such a way that any mill can feed any line and in limestone bunker area boiler side any line can feed to both bunkers of both the Units. Necessary pneumatic type isolation valves and diverter valves shall be provided for interconnection. On-off position feedbacks of these valves to control system shall be provided using proximity switches.

35. Instrument air tapping for operation of valves at boiler area only shall be provided from Main Plant instrument air.

36. The operation shall be from the Limestone control room and the necessary control panels shall be located in the Limestone control room.

37. The radius of 90DEGREE bends for limestone conveying pipes shall be minimum 5 times the pipe diameter.

38. Each of the product hoppers shall be provided with access ladder. The top of each of the product hopper shall be fully covered and shall be provided with a vent filter to enable venting pressurized air during discharge of powdered limestone from the mill.

39. The motor rating for all the equipment shall have a margin of 15% over the brake KW. The service factor for selection of gearboxes, resilient couplings, flexible couplings, brakes etc., shall be 1.5 minimum on the motor rating.

40. The type of high speed coupling between motor and gear box shall be resilience type (if the motor rating is less than 30kW) and the same is traction type fluid coupling (if the motor size is above 30 kW).

41. The emission level at the outlet of the bag filter shall be limited to 50mg / Nm³

**Layout and Maintenance Requirements**

**Layout Requirements**

42. The mills, the product hoppers and the transmitter vessels shall be located inside a covered shed. The shed shall be covered with Galvalum sheeting up to the hopper top all round. The shed shall be provided with a gap of about 250mm from the top for ventilation.

43. The overhead piping shall have a minimum working clearance of 3 metre over head room walkways and working areas.
44. All piping shall be arranged to provide clearance for the removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance.

45. Clear head room of 7 metre shall be provided below the pipe rack at the road crossing.

46. Hand railing shall be provided for all the opening for personnel safety.

**Maintenance Requirements**

47. Facilities for carrying out online and off-line maintenance of powdered lime stone milling and handling, conveying system and auxiliaries shall be provided. In general, this should include adequate handling equipment, working space, platforms and safety devices.

48. Suitable electrically operated handling system to handle motor and mill components shall be provided at all locations for erection and maintenance of the same.

49. Painting: Bidder shall refer section 11 of volume-II for painting.

**Control System & Instrumentation**

50. A common control room shall be provided for the following:
   a. Limestone handling plant controls
   b. Limestone milling plant(s) Controls
   c. Limestone conveying system controls

To limit dust ingress double entry doors shall be provided for the control room. The control room shall house all the control system panels for the aforementioned plants and also the 110VAC, 50Hz UPS system.

52. Cable entry, cable gallery/vault, UPS/PLC/AC&V control panel cut-outs etc. shall be considered for the same.

53. Control system shall be air-conditioned to maintain inside conditions of +24/+‐1.5 Deg. C & RH not exceeding 60% shall be considered with PAC units. Three numbers PAC (two working + one stand by) shall be provided for the purpose. Glass partitioning shall be provided b/w the operator and panel areas. The louvers/ diffusers for air conditioning and ventilation systems in control room etc shall be adjustable type so that differential temp control can be achieved for the panel and operator areas.

54. A common parallel redundant UPS system (110VAC, 50Hz, 2x100%) with SCVS bypass panel to be provided to cater to the power supply requirements of the control systems, HMI and field instruments. The power supply input to the UPS system shall be derived from three independent feeders, so that trip of two of the feeders does not affect the functioning of the UPS loads. The UPS capacity shall be finalized during detailed engineering and shall be at least 50% higher than the final load list. The power distribution to the UPS loads shall be through ACDB (AC Distribution Board) with individual fuse & MCB protection for each individual feeder. 20% spare UPS feeders shall be provided of assorted ratings.

55. Spacious control desk for operator & engineering stations, printer, minimum two no. medium size shelves with lock and five nos. good quality revolving chairs with high back rest, hand rest etc shall be supplied. Executive working tables shall be supplied for shift-in-charge.

56. Wooden wardrobe/cabinets shall be provisioned in the wall of control room with locking arrangement for keeping and maintaining all records.
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| 57. | There shall be common HMI for Limestone handling, Milling & Conveying systems. The HMI shall constitute five (5) Operator Work Stations (OWS), one (1) Engineering Work Station (EWS) and one Laptop for Engineering. Separate Hot-redundant PLC systems shall be provided for fully automatic operation of the following system/Plant:  
   a. Limestone handling plant  
   b. Limestone milling system  
   c. Limestone Conveying system  
   **Common PLC can also be offered as an alternative for limestone handling, milling, conveying**  
| 59. | Each of the afore mentioned PLC systems shall conform to the following:  
   a. The complete PLC hardware shall be G3 rated.  
   b. Each PLC shall have redundant hot standby processors, redundant power supply modules, & redundant communication modules.  
   c. Communication cables between CPU and remote I/O panel shall be redundant & armoured. The same shall be laid in conduits in separate routes.  
   d. The hot standby redundancy in CPU shall be an in-built feature of the hardware and shall not be software implemented.  
   e. The PLC CPU communication to HMI as well as I/O rack modules shall be redundant. Also the failure of one communication module shall not result into changeover of the CPU from primary to secondary. The communication cables shall be fibre optic cable & shall be redundant and armoured. The communication cables between PLC & remote I/O panels shall be laid in separate conduits in separate path. The armored fibre optic cable shall be laid in conduits.  
   f. The battery back-up type program memory is not envisaged. After restoration of PLC power after long interruptions, the PLC CPUs shall be capable to directly start and go to normal operating mode without the need to re-load any program.  
   g. Each PLC shall have a separate Redundant, Bi-directional OPC LINK to DCS.  
   h. The Digital Inputs as well as Digital outputs of PLC shall be galvanically isolated from the field using potential free relay contacts for all digital inputs & outputs. The redundant 24VDC Power supply for the PLC system shall be separate from the redundant power supply for the relay boards, field instruments, SOVs etc.  
| 60. | 2 Nos. Radar type level transmitter shall be provided in each Limestone Bunkers in the boiler area, Limestone raw bunker, etc. for limestone level measurement.  
| 61. | Any other C & I items required for fully automatic operation of the plant/system are in Bidder’s scope.  
| 62. | Vibration monitoring system shall be provided for limestone crushers and screens.  
| 63. | Bearing temperature monitoring (analog values) shall be provided for all HT drives, HT motors, crushers and any other such important drives. Further, temperature scanner is not envisaged and temperature element shall be directly acquired in respective PLC system.  
| 64. | **Complete Civil & Structural Work for limestone handling, milling and conveying system is in bidder’s scope. RCC/Structural Building, pipe racks, equipment/building foundation etc is in bidder’s scope.** |
1.06.00 TERMINAL POINTS

(a) Outlet flange of reclaim hopper in raw limestone stock yard. Downstream equipment from hopper outlet will be in bidder's scope.

(b) Outlet of terminal/target box(s) located on limestone bunkers in boiler area.

(c) DM water (for equipment cooling): At pressure of 6.0 kg/cm² (approx) at FGL near Limestone compressor house. Necessary pumps, piping, fittings shall be provided by bidder. DM water to be returned to the purchaser's return header outside the building.

(d) Service water/drinking water near each powdered limestone handling building terminating with a valve.

1.07.00 EXCLUSIONS

1. Limestone bunker along with Structure/building for housing limestone bunkers.

1.08.00 SPECIFIC REQUIREMENTS

1. In case of any deviation the bidder shall furnish/indicate the same clause by clause in enclosed deviation schedule (Vol – III). In the absence of duly filled in deviation schedule, it will be considered that the offer conforms to the specification requirements without any deviation.

2. Bidder shall furnish all drawings/data sheets/catalogues as indicated in different sections of specifications along with the offer in sufficient nos.

3. Makes of all sub-vendor items shall be subject to purchaser's approval during detail engineering and there shall be no commercial implication on account of the same. Various drgs/documents and Quality assurance plan submitted during detail engineering shall be subject to purchaser's approval without any commercial implication.

4. List of recommended spares for three (3) years with unit price to be quoted.

5. Erection and commissioning (start-up) spares as per requirement are included in bidder's scope and these shall be handed over to customer after completion of erection and commissioning. 5% of engineered quantity of each type of modules/accessories shall also be considered in start up spares for C & I.

6. List of maintenance tools and tackles to be quoted by bidder.
7. Only manual calculation with authentic supporting literature shall be furnished (e.g. Handbook /standards /codes).

8. Drawings and documents not covered above but required to check safety of machines /system shall be submitted during detailed engineering stage without any commercial implication.

9. All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

10. Any approval required from any statutory/regulatory bodies shall be arranged by bidder/vendor on behalf of customer.
1.09.0 GENERAL DESIGN GUIDELINES & STANDARD EQUIPMENT SIZING CRITERIANS

a) Bulk Density for Limestone for Volumetric Sizing : 1200 kg/m³
b) Bulk Density for Limestone for Structural Sizing : 2200 kg/m³
c) Angle of repose and surcharge : 35 & 20 deg
d) Top lump size of as received limestone up to crusher house : 150 mm
e) Top lump size of limestone downstream of crusher house to Raw limestone bunker : (-) 25 mm
f) Maximum moisture considered for hot air generator design and belt conveying system : 20%
g) Air-Powdered limestone mixture conveying velocity : As per proven technology of system suppliers
h) Bends in the pneumatic handling system : Ni Hard/Alloy Cl, 400-450 BHN
i) Type of bends for pneumatic conveying system : Radius of 90° bends will minimum 5 times the pipe diameter.
j) High level probes provided in product hopper and Pressure transmitters : Yes, RF type
j) Level measurement device in Crushed limestone bunker : Yes, Ultrasonic level transmitter
k) Vent valves for the transmitter vessels will be provided above the highest powdered limestone level in the product hopper.
l) The motor rating for all the equipment will have a margin of 10% over the BKW considering highest system frequency for selecting motor rating. The service factor for selection of gearboxes, resilient couplings, flexible couplings, brakes etc., will be minimum 1.5 on the motor rating. Motors shall be capable of staring and accelerating the load with the applicable method of starting without exceeding acceptable winding temperature when supply voltage is 80% of the rated voltage for HT motors and 85% for LV motors. HT motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage for 5 min. commencing from hot condition. All continuous duty LT motors shall be energy efficient class (IEEMA-EEF 1 class).

m) Limestone handling system – Selection criteria
1. All the equipment shall normally handle limestone continuously at the rated capacity. However for
calculating motor rating based on density of 1200 kg/m3 of compacted limestone, a margin of 25% over the
rated capacity shall be considered.

2. All the belt conveyor, belt & shuttle feeder drives shall be provided with conventional electro mechanical
drives.

3. Surface moisture content of limestone during rainy season shall be considered for design of equipment
as 20% respectively.

4. The ratings of motors, sizes of gearboxes, couplings and pulleys for conveyors shall be standardized. The
different types of motors, gearboxes and couplings and pulleys of different conveyors and of different
types shall be limited to minimum possible.

5. All equipment drives shall be capable of starting on full load. Rack and pinion gates, if any, shall be
suitable for closing and opening with hopper full of material.

6. The motor rating for all equipment shall have a minimum margin of 10% over the BKW. The service factor for
selection of gear boxes, flexible & resilient couplings (equipment with electro-mechanical drives), brakes,
etc. shall be minimum 1.5 on the motor rating.

7. Speed reduction units for all equipment with drive motor rating of above 10 kW shall be ground and
hardened helical / bevel helical type. Bevel helical or helical gearbox shall be provided for eccentric disc
screens to suit the layout. The gearboxes shall be provided with fan cooling arrangement wherever
required and water-cooling arrangement shall not be provided. Gearboxes shall be provided with
flooding lubrication. Oil seals shall be mechanical type. Hollow shaft gear boxes shall be provided with shrink
disc fit up arrangement. For all the inclined conveyors integral type hold back shall be provided in the gear
box.

8. The type of high speed coupling between motor and gear box shall be as follows:

9. For motor rating up to 30 kW - Resilient type.
10. For LT motors of above 30 kW - Traction type fluid coupling
11. For HT motors - Actuator operated scoop type fluid coupling
12. For the scoop type fluid coupling, fan cooling arrangement shall be provided. Water cooling is not
acceptable. Fixed body type scoop control fluid coupling followed by electrical actuator to be provided.
Whenever equipment provided with HT motor trips due to fault in itself or due to tripping of succeeding
conveyor/equipment, the fluid in the fluid coupling shall be emptied by the scoop for disengaging the motor
from the load and the HT motor shall continue to run. The actuation time of the scoop tube actuator shall be
less than the coasting time of the succeeding conveyor/equipment. Scoop controlled fluid couplings shall be
fix body type and both side end connection shall be designed in such a way that complete scoop coupling
can be removed without disturbing the alignment of motor and gear boxes.

13. All inclined conveyors shall be provided with cam roller type hold back integral with the gear box in
addition to thruster brakes to prevent reverse rotation of conveyor in the event of power failure under all weather conditions. The rating of the holdbacks shall be 1.5 times the full load torque of the drive and shall be provided in the intermediate shaft of the gear box. Hold backs shall be provided on the non drive end of drive / head pulley shaft. Hold backs of ratchet and pawl type are not acceptable.

14. Electro-hydraulic type thruster operated disc brakes provided on all inclined conveyors shall serve as back up to hold back. These shall also be used for adjusting the coasting times of different conveyors. On horizontal conveyors, if brakes are required to adjust the coasting time, the same shall be provided and shall be of electro-hydraulic thruster brakes. The brake actuation time without delay relay shall be limited to 3 seconds. The couplings between gearbox and driven equipment shall be of resilient type.

15. All equipment drives including conveyors including crusher drives shall be capable of starting fully loaded equipment. Rack and pinion gates if any shall be suitable for opening and closing with hopper/chute full with material. Electro-hydraulic type thruster operated disc brakes shall be provided for all conveyors, feeders, equipments wherever applicable.

16. All the bearing pedestals shall be of horizontal split type for easy inspection with four bolt fixing.

17. Friction coefficient "µ" (between drive pulley and the belt) shall be considered as 0.275 for arriving at tight side / slack side tension.

18. All conveyor drives shall be single snub pulley drive with minimum angle of wrap of 210 deg.

19. The radius of curvature for all conveyors shall be calculated as per IS: 11592. However, while calculating radius of curvature for travelling trippers or stacker cum reclaimers, the maximum tension (Tc max) at the curve may be calculated based on 20% of the full load. The head end of conveyor shall preferably be horizontal and horizontal length of conveyor at head end shall be minimum 3 meters. The maximum spacing of carrying idlers in the convex curve portion of conveyor shall be limited to half the normal spacing of carrying idlers. The tail end also shall be preferably horizontal.

20. Conveyors carrying 300mm size lignite shall have a maximum inclination of 12° and all other conveyors carrying (>) 50 mm size and (>) 10 mm size lignite shall have a maximum inclination of 14°.

21. For all conveyors, transition idlers of 5°, 15° and 20° shall be provided at either end at a spacing similar to other carrying idlers.

22. The skirt boards shall be terminated over an idler.

23. Snub pulleys of all conveyors at head end shall be covered in the main discharge chute.

24. For over ground conveyors, take-up shall not be provided in the pits. The take up shall be positioned so that the lower end of the take up weight is not more than 1.5 m from the ground. GI Chain Link around the take up weight for a height of 2.5 m shall be provided. Sand pit shall be provided at the ground level. The counter weights shall be cast iron of suitable size for easy handling.

25. The coasting time of conveyors and feeders shall be adjusted such the material discharge and equipment shall have highest coasting time and the preceding equipment shall have equal or lower in descending order.
26. The design of belt conveyors shall be as per IS - 11592. The artificial co-efficient of friction shall be considered as 0.03 for calculating the power requirement for conveyors.

27. Conveyor idler rollers and pulley shell below the magnetic separators shall be of non-magnetic material (stainless steel). Also the deck plate & main chute plate up to the flanges just below the conveyor floor shall also be made of stainless steel.

28. Design of chute and hopper outlets should be such that wet and sticky lignite shall flow freely without arching / plugging of chutes. The sizes of chutes and hopper outlets shall be large enough to achieve this. The chutes shall have preferably semi-circular cross section nearer to feed points to conveyors so that the material while feeding on conveyor can be centralized. The chutes shall be as far as possible straight and where bends have to be provided a minimum side plate angle of 70 deg for lignite & 60 deg for limestone and hopper side plate angle shall be minimum 70 deg for lignite & 65 for limestone. Hopper provided up stream of the screens with multiple outlets shall be designed in such a manner that wet sticky lignite flows freely and no blockages take place. The reclaim hopper shall be provided with a shed and maintenance platform and access staircase to carry out any maintenance in the event of any flow problems at different elevations and floors. Reclaim hopper shall be provided with poke holes for clearing blockages if any with proper approach platforms. Other hoppers shall be provided with a maintenance platform and access stairs to carry out any maintenance in the event of any flow problems.

29. Considerations of secondary resistance to additional impending forces:

30. Minimum 3 kW per 1 m/sec belt speed for tripper of stacker cum reclaimer.

31. Minimum 0.15 kW for 1m length of skirt board and a belt speed of 1M/Sec.

32. Crowned / gabled deck plates shall be used to effect drainage of water while washing. The deck plates of all conveyors shall be provided with ribs at frequent intervals to have adequate stiffness. The ribs shall be provided in the transverse direction to the direction of travel conveyor.

33. Safety guards shall be provided for drive pulleys and tail pulleys of all conveyors and feeders, couplings, brake drums of all conveyors and hydraulic drives. All over ground conveyors shall be provided with covered galleries.

34. The drive motor of all the sump pumps shall be mounted at least 1.0 meter above the floor level.

35. Take-up arrangement, safety guards, etc., shall be as per relevant Indian standards.

36. For natural ventilation of galleries of above ground conveyors, a gap of 300 mm shall be provided throughout the length of gallery between roof and side cladding at the top and 200 mm at the bottom. Electro forged gratings in walkways shall be provided.

37. All conveyor galleries shall be provided with Perspex sheets on the roof and on the sides of gallery at every 10 M intervals for natural lighting in the galleries. Sheet cladding shall be provided for roof and side cladding for galleries and junction towers as per civil specification.

38. The bottom portion of all galleries of conveyors running at an elevation 1.5m above the grade level and whichever are crossing buildings, roads, main plant areas, etc., shall be provided with seal plates along the
entire length of gallery as applicable of 3.15 mm thick MS below the return run of belt covering the entire opening. Also, the walkways shall be provided with Electro forged grating only.

39. Painting (for mechanical equipment and technological structures) shall be as per section 11 of this specification.

40. Adequate no. of hoists (manual / electrical) shall be provided for handling the equipment / components, etc. in primary & secondary crusher houses, screen house, junction towers and other places. The minimum capacity of the hoist specified elsewhere in the specification shall be provided by the Bidder. 2 x 100 % Sump pumps shall be provided for each underground structures like conveyor tunnels, etc. and for the lignite & limestone handling compressor room. These pumps shall be suitable to handle lignite slurry and impeller shall be of open type.

41. All equipment should be provided with energy meters to calculate the energy consumption.

42. All loading boot shall be curved back type to ensure loading on conveyors in center.

43. Design of the screen and crusher house shall be done in such a way that its Floor level of the building should be about 1 meter above the Finish floor level in that area. Also Crusher foundation and surrounding supporting structure should be designed in such a way that there should be sufficient space for maintenance work.

44. In all conveyors, numbering to be done for carrying idler frames at the interval of every five frame and every frame of return idlers.

45. Screen vibration monitors to be provided with shut down module. Vibration monitoring system shall be provided for the screens.

46. Flexi seal type skirt boards to be provided at all transfer points.

47. Block chute probe protection to be provided in all conveyor transfer chutes.

48. All receiving point of all conveyors shall be in horizontal position and all flexi seal skirt rubbers shall not have any inclination.

49. All drives pulleys shall be provided with ceramic lagging only.

50. The clearance between the bottom of the tail pulley and floor in junction tower/crusher houses/reclaim hoppers shall be adequate to avoid fouling of the return belt with spilled material and it shall be minimum 500 mm. Also, a minimum clearance of 300 mm shall be provided below tail snub pulley, wherever applicable.

51. Belt conveyors / belt feeders

1. The fire retardant anti-static (FRAS) belt used for conveyor shall be carefully selected considering the service requirements, loading cycle, loading and unloading points. It shall be adequately designed to convey the required tonnage of the material of specified lump size. The number of plies and tensile strength shall be suitable for the performance required. The plies shall be skim-coated and the belt shall be mill dew resistant.
2. The carcass shall have adequate strength and adequate number of plies. Maximum allowable belt tension shall be considered as 10% of the belt strength for EP belts. Maximum tension during normal operating condition with load shall be considered for checking against 90% of maximum allowable tension of conveyor belt. The cover shall be of fire retardant type as per data sheet-A. The cover thickness shall be as specified in data sheet-A. The belt shall be constructed to facilitate mounting and running on troughed idlers. The Bidder shall include in his supply sufficient length of belt to take care of field splicing. The belt shall have enough edge rubber anchorage to resist end wear. The belts shall be of molded edge construction and not cut edge type.

3. The percentage of elongation shall be limited to 3% of belt length. However, take up travel shall be based on minimum 2.5% of length of the conveyor + 600mm. The percentage of belt sag shall be based on IS: 11592.

52 Idler Units

1. All idler rolls shall be manufactured from ERW tubes conforming to latest edition of IS: 9295 or from seamless tubes conforming to IS: 3601 / BS-1775. The bearing housings shall be pressed steel and both the bearing housings shall be welded to the rolls simultaneously. Minimum thickness of bearing housings shall be 3 mm. The maximum friction of each idler unit shall not exceed 0.015.

2. The idler units shall be heavy duty and suitable for continuous operation at high capacities. In the case of troughing idlers having rolls of equal length, the rolls as well as the roll components shall be interchangeable.

3. The frames for all fixed type troughing units shall be steel or malleable form with provision for securely bolting to the stringers of the conveyor frames. All fixing bolts shall have spring washers. Slotted holes of 1.5D on both sides of the frames shall be provided. For the impact type units, the rolls shall be made of steel tube and securely held in place. The rolls for all other troughing units shall be of tubular steel construction. Idler spacing at loading points shall be reduced to prevent excessive sag. The first impact idler shall be placed approx. 150 mm behind the loading point.

4. Each roll for all idlers shall be equipped with an approved make of anti-friction bearings of ample capacity and shall have minimum double labyrinth type seals for keeping the lubricant in and dirt out. The bearings and the sealing devices shall be mounted in an internal structure that shall ensure alignment, proper spacing and good support and minimise the size of the lubricant chamber. Each roll and the pivoted support for each self-aligning unit shall be provided with an adequate means for pressure gun lubrication. All grease fittings shall be of button head type or equivalent and shall be accessible from the walkway side of the conveyor by piping across, if necessary. The grease tubing shall be made of aluminum. The grease fittings shall have plastic caps for protection against dust collection. Wherever two (2) conveyors are situated adjacent to each other, they shall be arranged for lubrication from the walkway between them. The idler bearings shall be anti-seize single row deep
groove ball bearing of double side sealed type. Minimum life of all life lubricated idler bearings shall be 30,000 working hours.

5. For conveyors having belt width 1400mm, the return and return training idlers shall be 2 roll 150 V-type. For horizontal portion of conveyors of 500m long & above, festoon type 150, 2 roll V-type return and return training idlers shall be provided. For horizontal portion of conveyors less than 500m, single roll return and return training idlers shall be provided. The return idlers shall be connected to the steel rod brackets of minimum 16 mm diameter. Two sets of brackets shall be provided for each idler for aligning and training of conveyor or belt. Wherever festoon type return idlers are used, self-aligning return idlers need not be provided. The spacing of V-type return idlers shall also be limited to 3m. However, the spacing near the head pulley and tail pulley shall be less than 3.0m. All self-aligning idler units shall be offset castor cambers type with a provided frame mounted on anti-friction bearings. Self-aligning idlers where provided on the carrying and return runs shall be placed about 15 m from each terminal or bend pulley and approximately 24 m apart thereafter, the side brackets for all idlers shall be of pressed ‘C’ type. The supports for the self-aligning idlers shall be made of steel or malleable iron with provision for securely bolting to the underside of the stringers. The rolls for the other return idlers shall be mounted on sturdy steel or malleable iron brackets bolted to the underside of the stringers. Bearings, sealing devices, bearing mountings and lubrication arrangements for return idlers of conveyor and all the belt feeder idlers shall be similar to those outlined above.

6. For a particular size of belt, each type of idler and their component shall be identical to ensure interchangeability. All rollers of the same size shall also be fully interchangeable. Minimum 5 Nos. of impact idlers shall be provided at each feed point. In all conveyors, carrying idler frames shall be numbered at intervals of every five frames. Regarding return idlers, every frame shall be numbered.

53. Pulley units

1. The width and depth of grooves shall be 6 mm spaced at 30mm interval. The shore hardness of rubber shall be minimum 550 Scale – A for drive pulleys and 450 Scale - A for other pulleys. The shore hardness of drive pulleys shall be mounted such that the apex of the herringbone grooves points in the direction that the pulleys rotate. All lagging shall be accurately fitted and vulcanized to the pulleys. For the drive pulleys, the lagging shall be located to provide a belt wrap on the drive pulley of not less than 2100. The drive pulleys of reversible conveyors / feeders hall be provided with ceramic rubber lagging.

2. All pulleys, drive and take up, shall be connected to the shafts through keyless friction grip connection of approved make. The deflection of all pulley shafts shall be limited to 1/2000 at the middle of the shaft with respect to centre to centre of bearings. The combined shear stress in the drive pulley shaft based on the normal torque of driving motor shall not exceed 500 kg/sq.cm, deflection at hub limited to 8 min. The shaft diameter of the drive pulley shall have to be determined considering the maximum diameter of
3. Pulley shaft of 150 mm diameter and less shall be made of machined hot rolled or turned and ground cold finished carbon steel. Pulley shafts larger than 150 mm in diameter shall be made of carbon steel forging (C-40 or better). All pulleys shall have a carbon content of not less than 0.35%. Each shaft shall be amply proportioned for both strength and stiffness. Reduction of diameter of the shafts at the bearings shall be permitted if the bearings for the reduced sizes have the required life and load ratings.

4. Reduction of diameter at the bearings for shafts of 150 mm and smaller shall not exceed 12 mm. All shafts shall be straight and true with fits and surface conditions suitable for mating parts and when practicable with fillet radii of not less than 6.0 mm where changes of section occur. Sunk straight keys shall be provided for securing the shaft and pulley parts.

5. All shafts shall be supported by heavy duty, horizontal split type pillow blocks of 4 bolts construction equipped with self-aligning spherical roller bearings and adequate sealing devices for keeping the lubricant in and dirt out. All pulley bearings shall have both ends fully covered except the drive side bearings of drive pulleys. The bearings and Plummer blocks shall be of approved make. One bearing for each shaft shall be fixed to prevent any movement of the shaft assembly and the other bearing shall be floating to have free axial movement. All Plummer blocks for shafts less than 75 mm diameter except drive pulley shafts may be mounted on the supporting structure by just two bolts. All pillow blocks for shafts above 75 mm shall have four mounting bolts. Pillow blocks for drive pulley shaft less than 75 mm shall have four mounting bolts. Adjustable screws with locking nuts shall be provided on each side of all Plummer blocks for aligning and holding pulley units. All Plummer blocks shall be mounted on machined surfaces supporting the full face of Plummer block.

6. Each plummer block shall be equipped with a button head or equivalent type grease fittings for pressure gun lubrication, an approved type relief fitting for preventing building up too much grease pressure and a suitable drain for removing old lubricant. Where required grease fittings shall be located in an accessible position and provide piping to the plummer block. Either plummer blocks or bearings units of pulleys shall be provided with multi-labyrinth type dust seals to prevent ingress of dust into the bearings.

7. All pulleys shall be statically balanced to minimize the vibrations during running. All pulley diameters adopted shall be selected based on the percentage of belt tension as per IS: 1891. All head pulleys of conveyors with HT drives and tripper pulley of stacker cum reclaimer shall be provided with cast steel turbo diaphragm end disc. All other pulleys shall be provided with MS steel hub welded with end disc and shell. All bends, snub and tail pulleys shall be shell mounted with pulley rotating and shaft being fixed. Pressure pulley shall be provided after snub pulley.
1. The sloping back of each transfer chute shall be spaced from the return belt to permit use of a belt cleaning unit and arranged such that the dribbles shall be returned to the same chute that is handling the main flow of material. On tail pulleys, scraper shall be included on pulley contact surface of belt with discharge chutes at approved locations. Dribble removal chutes and auxiliary scrapers shall be provided wherever required in order to return dribble to the system or to displace it to points where it may be conveniently shoveled back into the system.

Multi blade torsion arm type belt cleaners

1. The belt cleaner shall consist of a row of blades made of polyurethane backed by steel plates. These blades shall be capable of being set perpendicular to the belt surfaces but diagonal to the belt travel. Each blade shall be pivoted upon an individual torsioned spring, which presses the wiping edge gently, but firmly against the belt. Blades shall overlap to cover the entire carrying width of the belt. The polyurethane strips shall be adjustable after wear.

Sprung Blade type Belt Cleaner

1. The blade of the belt cleaner shall be made of spring steel so that the cleaning is effective. The material of blade and construction of cleaner shall be such that the blade shall lift in the event of any foreign material or at the metal joint of conveyor belt.

55 Chutes, Skirtings, Switches, Frames, Deck Plates And Belt Housings

1. Bidder shall furnish all chutes, skirtings, rubber seals, felt gaskets, housings, hanger rods, hanger rod end brackets and chute supports as needed to provide the complete lignite & limestone handling system outlined in this specification. The chutes, skirtings and housing shall be welded and bolted units made of structural steel plates, unless otherwise specified. All units shall be made as dust tight as practicable. Bolted joints shall be provided with felt gaskets. Provision for ready access to the interiors of skirtings, housing and other possible trouble points shall be made by means of readily removable, bolted on plates or by hinged and latched doors.

2. All chutes shall be fitted with hinged inspection doors with proper sealing. The outlet opening size of chutes along the length of conveyor shall be based on minimum two times the lump size or three times the flow rates through the chute depending upon whichever gives maximum dimension. The minimum dimension of outlet of chute across the conveyor shall be 2/3rd belt width. The chute hood shall be provided with baffle plates to guide the lignite into the discharge chute. The location of the
baffle plate shall be adjustable. The chutes shall also be provided with dust curtains.

3. All skirt plates shall be made of steel plates having a minimum thickness of 12.0 mm. All cover plates for skirt boards shall be of 4.0 mm (minimum) thick steel. Conveyor skirtings at loading points shall be equipped with rubber dust flaps and polyurethane sealing strip where needed to provide a substantially dust tight job. The polyurethane blocks used for skirt board sealing shall be made of 15 to 20 mm thick blocks. Flexi-seal type skirt board shall be provided at all transfer points which shall be of individual block adjustment type. These shall allow adjustment for wear in small increments in any point along with conveyor belt using only a hammer. The backing plate shall be permanently fixed to skirt plate of the conveyor belt. The clamp for polyurethane blade shall allow only downward movements of blade and not upwards. The sealing block shall be replaceable module. The skirtings below the crushers shall be equipped with hinged adjustable deflector plates. Skirtings at discharge ends of all conveyors shall be equipped with rubber dust flaps only. The length of skirt boards at each feeding point shall be not less than 5.0 m from leading edge of chute. Continuous skirt boards shall be provided wherever feeds from multiple points on the one conveyor are involved.

4. All stringers of conveyors and belt feeders, head and tail pulley frames shall be of standard quality and welded and bolted steel structures. Each stringer, head frame and tail pulley frame shall be a welded self-contained unit ready to be set in place and connected to the structures and to adjacent conveyor parts. Attachment of the conveyor frames to the steel supporting structures shall be by field bolting and to the concrete structures by bolt anchors.

5. Dedicated siren system with LED type warning lamps shall be provided for each conveyor.

6. All Belt protection switches shall be non-flame-proof type with IP-65 protection for over ground conveyor.

Shuttle Feeders / Belt feeders/ Reversible shuttle feeders/Vibrating feeders

1. The feeders shall be supplied complete with an endless belt, closely spaced idlers, head and tail pulleys with shafts and pillow blocks, screw type take up, drive unit, steel work, electrical outfits and other accessories.

2. The idlers for feeders shall be closely spaced impact idlers. The endless rubber belt selected shall be suitable for the required duty considering the service conditions, unloading and loading cycles. The plies shall be skim coated and the belt shall be mildew resistant. The fabricated steel framework shall be self-contained and sturdy. Skirt plates shall run for the full length of the feeder to confine the material and provide necessary depth for desired capacity.

3. The drive unit shall be adequately designed for handling the required capacity and shall be rated for 24 hours continuous operation. The mounting base shall be rigidly constructed, adequately braced and provided with finish pads for mounting the motor with a separate reducer unit or geared motor. Each floor-mounted motor shall be provided with two locating dowels on opposite feet or locating
shear bars and also each reducer and geared motor shall be provided with shear bars or dowels of sufficient size to resist the total shear load. Fluid couplings shall be installed between motors and gear reduction units for all feeders with scoop type fluid couplings provided for H.T drives. These shall be supported independently from the drive base plate. The scoop actuator for disengaging the motor from load shall be limited to 3 seconds.

4. Safety guards shall be provided for drive pulleys and tail pulleys of all conveyors and feeders, couplings guards and brake drums of all electro-mechanical drives.

5. All other features of individual components not mentioned herein shall be as per the above clauses.

6. Mechanical vibrating feeders shall consist of a spring suspended or floor mounted trough actuated by a mechanical vibrator assembly, mounted on the trough frame. The mechanical vibrator assembly shall consist of either one unbalanced shaft producing a particular line of action for vibration or two unbalanced geared shafts operating at same speed and producing a particular line of action for vibration or producing resultant forces in a particular line of action say at 45 deg. angle. The shafts shall be supported by heavy-duty anti-friction spherical roller bearings in a suitable housing. The drive unit shall consist of a motor coupled to the vibrating unit through ‘V’ belt and pulleys. Suitable lubrication arrangement shall be provided for the main bearings.

7. All rotating/reciprocating parts such as couplings, ‘V’ belt drives, etc. shall be covered with suitable protective guards.

56. Crushers

Secondary Crushers (Hammer Mills for limestone)

The features of hammer mills shall be generally the same as those of ring type granulators regarding frame, cage, shaft, tramp iron trap, internal or external bypass for crusher, bearings and method of lubrication, drive details, etc. Hammers fitted on to the shaft shall be adequately designed for the service intended and shall be made of manganese or similar abrasion resistant alloy steel. The gears shall be preferably of high tensile steel. A heavy-duty relief spring shall be provided for absorption of shock. It shall be possible to run the secondary crusher in reverse direction in case of overload or any other tripping. The method of opening of maintenance door shall be by hydraulic cylinder.

57. Vibrating screens

The vibrating screen shall be supplied complete with all the mechanical, electrical, structural and other accessories. Mechanical vibrating screens shall consist of spring suspended or floor mounted trough actuated by a mechanical vibrator assembly mounted on a trough frame. The drive unit shall be capable of operating at 24 hours continues duty and shall consist of a motor, coupled to the vibrating
unit through V-belt and pulleys. The supporting structure shall be adequately designed for the required duty. The lubrication system for the main bearing shall be preferably of oil bath lubrication.

58. TRAVELLING TRIPPER

DESIGN REQUIREMENTS

1. The travelling tripper shall be complete with steel structure & frame work, idlers, bend pulleys, drive unit, discharge chute, scrapers, wheel and axle outfit with pillow blocks and other accessories.

2. The tripper shall be motorized unit. It shall have a rigid welded steel framework to resist shocks and distortion. The framework shall be constructed out of steel plates and structural, well-ribbed and braced. Welded steel supports shall be provided for mounting all machinery elements. The tripper shall also be equipped with a welded steel crossover platform, providing access to both sides of the tripper conveyor, complete with ladders, toe guards and hand railing. Discharge chute as specified in Data Sheet-A constructed from minimum 10 mm M.S. Plates complete with replaceable 5 mm thick SS liner plates shall be included.

3. DRIVE ARRANGEMENT

Each tripper shall be supported by not less than four double flanged wheels. The wheels shall be made of cast steel. Steel plates guard shall be provided for each wheel. Each wheel shall be keyed to a steel axle of ample strength. Each axle shall rotate in and be supported by heavy duty pillow blocks secured to the underside of the tripper frame. Each pillow block shall be equipped with an anti-friction bearing of approved make, type and capacity. Each bearing shall be protected from loss of lubricant and entrance of dirt by approved type of grease seals. Suitable button head-type or equivalent fittings for grease gun lubrication of the bearings shall be provided. The tripper shall be complete with drive motor, electro-magnetic brake, gear box, all cables, cable reeling drums, and necessary limit switches for preventing over travel on the rails. The tripper shall be provided with necessary arrangement for forward as well as reverse motions. The tripper shall be provided with cable reeling drum to enable power supply for all drives and other requirements. The length of power and control cables shall be suitable for tripper travel distance.
Appendix- I

RAW LIMETOSNE AS RECEIVED AT SITE: 150 mm

LIMESTONE FEED SIZE (FEED Size) TO LIMESTONE BUNKER

Crushed Limestone shall be to 90% below 25mm and 10% up to 40mm in size

LIMESTONE ANALYSIS (As received)

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<td>Silica as SiO₂</td>
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<td>2.0</td>
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POWDERED LIMESTONE SIEVE ANALYSIS (Product Output of mill, Input to Boiler):

100% less than 1mm
80% less than 0.2mm
50% less than 0.16mm
90% greater than 0.04mm

Bunker elevation in boiler : 46 m(approx), four bunkers in each boiler.

List of Drawing enclosed with the tender specification
1. Flow diagram Limestone handling system; PE-DG-STD-170-A001, R0
2. Flow diagram Limestone Milling and conveying system; PE-DG-STD-170-A002, R0
3. Plot Plan, PE-DG-STD-100-M001, R2

Appendix - 2

1.0 CODES AND STANDARDS

1.1 All equipment, system and services covered under this specification shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of bid opening. Nothing in this specification shall be construed to relieve the BIDDER of this responsibility.

1.2 The standards not indicated in the specification are also acceptable subject to the approval of OWNER/ENGINEER, if they are established to be equal or superior to the standards indicated in the specification.

1.3 The metric units/SI units shall be used in all data/drawings submitted against this package.

1.4 If the Bidder offers equipment and systems conforming to other International Standards than those specified in the specification, the English translation of such standards shall be furnished by the Bidder along with the Bid. In such a case, if such standards are acceptable to the OWNER/ENGINEER the stipulations of the English version of the Standards shall alone be binding and not the stipulations in the original language.

1.5 In the event of any conflict between the codes and the standards referred to elsewhere in the specification and the requirements of this specification, more stringent of the two shall govern.

2.0 The indicative list of Codes and standards is furnished below for reference of the main plant package bidder.

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<td>ASME section II (Part A, B and C)- Materials (Ferrous, Non Ferrous and filler materials respectively.)</td>
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<td>ASME Section V – code of practice for Non Destructive Testing</td>
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<td>ASME Section VIII – Code of practice for Pressure vessels.</td>
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<td>Pipe flanges and flanged fittings</td>
</tr>
<tr>
<td>3.15</td>
<td><strong>ASME B16.9</strong></td>
</tr>
<tr>
<td></td>
<td>Factory-made wrought steel butt welding fittings</td>
</tr>
<tr>
<td>3.16</td>
<td><strong>ASME B31.1</strong></td>
</tr>
<tr>
<td></td>
<td>Power piping</td>
</tr>
<tr>
<td>3.17</td>
<td><strong>ASME B36.10M</strong></td>
</tr>
<tr>
<td></td>
<td>Welded and seamless wrought steel pipe</td>
</tr>
<tr>
<td>3.18</td>
<td><strong>ASME B36.19M</strong></td>
</tr>
<tr>
<td></td>
<td>Stainless steel pipe</td>
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<tr>
<td>3.19</td>
<td><strong>ASME PTC8.2 Centrifugal pumps</strong></td>
</tr>
<tr>
<td>3.20</td>
<td><strong>ASME PV CODE 8 DIV.1 Pressure vessels – division 1</strong></td>
</tr>
<tr>
<td>3.21</td>
<td><strong>ASME PV CODE 9 - Welding &amp; brazing qualifications</strong></td>
</tr>
<tr>
<td>3.22</td>
<td><strong>ASTM A 105 / A105M</strong></td>
</tr>
<tr>
<td></td>
<td>Specification for carbon steel forging for piping applications</td>
</tr>
<tr>
<td>SL NO</td>
<td>TITLE OF THE STANDARD</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>3.23</td>
<td>ASTM A 106</td>
</tr>
<tr>
<td></td>
<td>Specification for seamless carbon steel pipe for high temperature service.</td>
</tr>
<tr>
<td>3.24</td>
<td>ASTM A 182 / A182M</td>
</tr>
<tr>
<td></td>
<td>Specification for forged or rolled alloy steel pipe flanges, forged fittings and valves and parts for high temperature service.</td>
</tr>
<tr>
<td>3.25</td>
<td>ASTM A 193 / A193M</td>
</tr>
<tr>
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<td>Specification for alloy steel and stainless steel bolting materials for high temperature service.</td>
</tr>
<tr>
<td>3.26</td>
<td>ASTM A 194/A194M</td>
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<tr>
<td></td>
<td>Specification for carbon and alloy steel nuts for bolts for high pressure or high temperature service or both.</td>
</tr>
<tr>
<td>3.27</td>
<td>ASTM A 216 / A216M</td>
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<tr>
<td></td>
<td>Specification for steel castings, carbon suitable for fusion welding or high temperature service.</td>
</tr>
<tr>
<td>3.29</td>
<td>ASTM A 312 / A312M</td>
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<tr>
<td></td>
<td>Specification for seamless and welded austenitic stainless steel pipe.</td>
</tr>
<tr>
<td>3.30</td>
<td>ASTM A 333 / A333M</td>
</tr>
<tr>
<td></td>
<td>Specification for seamless and welded steel pipe for low temperature service.</td>
</tr>
<tr>
<td>3.31</td>
<td>ASTM A 403 / A403M</td>
</tr>
<tr>
<td></td>
<td>Standard specification for wrought austentic stainless steel piping fittings.</td>
</tr>
<tr>
<td>4.0</td>
<td>EJMA</td>
</tr>
<tr>
<td></td>
<td>Standards of the expansion joint manufacturers association.</td>
</tr>
<tr>
<td>5.0</td>
<td>EN 287 PT1</td>
</tr>
<tr>
<td></td>
<td>Approval testing of welders – fusion welding – steels.</td>
</tr>
<tr>
<td>5.1</td>
<td>EN 288 PT3</td>
</tr>
<tr>
<td></td>
<td>Specification and approval of welding procedures for metallic materials – welding procedure tests for the arc welding of steels.</td>
</tr>
<tr>
<td>6.0</td>
<td>American Welding Society (AWS)</td>
</tr>
<tr>
<td>7.0</td>
<td>Indian Boiler Regulations (IBR)</td>
</tr>
<tr>
<td>8.0</td>
<td>BS 848 – Fans for general purpose</td>
</tr>
<tr>
<td>9.0</td>
<td>National Fire Protection Association (NFPA)</td>
</tr>
<tr>
<td>a)</td>
<td>NFPA –10 : Portable extinguishers</td>
</tr>
<tr>
<td>b)</td>
<td>NFPA 12: Carbon-di-oxide extinguishing systems</td>
</tr>
<tr>
<td>c)</td>
<td>NFPA 13: Installation of sprinkler systems</td>
</tr>
<tr>
<td>d)</td>
<td>NFPA 15: Water spray fixed systems for fire protection</td>
</tr>
<tr>
<td>e)</td>
<td>NFPA 16 : Installation of deluge foam – water sprinkler and foam water spray systems</td>
</tr>
</tbody>
</table>
f) NFPA 85 C: Prevention of furnace explosions/implosions in multiple boiler furnaces

g) NFPA 850: Recommended Practice for fire protection of electric generating plants and High voltage DC converter stations.

10.0 Hydraulic Institute Standards (HIS)

11.0 Heat Exchange Institute (HEI)

12.0 Tubular Exchange Manufacturer's Association (TEMA)

13.0 International Organisation for Standardisation (ISO)

19.0 Tariff Advisory Committee (TAC) of India

20.0 Loss Prevention Association (LPA) of India

21.0 American Society for Heating Refrigeration and Air-conditioning Engineers (ASHRAE)

22.0 Indian Standards (IS)

   (i) IS 5: Colours for ready mixed paints and enamels
   (ii) IS 277: Galvanised Steel sheets
   (iii) IS 520: Standard for positive displacement refrigerant condenser and refrigerant units
   (iv) IS 655: Metal air ducts
   (v) IS 659: Safety code for air conditioning/mechanical refrigeration
   (vi) IS 702: Industrial Bitumen
   (vii) IS 803: Code of practice for design, fabrication, erection of vertical mild steel cylindrical welded oil storage tanks.
   (viii) IS 807: Code of practice for design, manufacture, erection, testing (structural portion) of cranes and hoists
   (ix) IS 903: Specification for fire hose delivery couplings, branch pipes, nozzles and nozzle spanner
   (x) IS 940: Portable fire extinguishers, water type (gas cartridge)
   (xi) IS 1239: Mild steel tubes, Tubulars and other wrought steel Fittings, specification – Part 1
   (xii) IS 1303: Glossary of terms relating to paints
   (xiii) IS 2062: Steel for general structural purposes
   (xiv) IS 2266: Steel wire ropes for general engineering purposes
   (xv) IS 2312: Propeller type AC ventilation fans
   (xvi) IS 2379: Colour code for identification of pipelines
   (xvii) IS 2871: Specification for branch pipe, universal for fire fighting purposes
   (xviii) IS 3034: Fire safety of industrial buildings: Electrical generating and distribution stations – Code of practice
   (ixx) IS 3041: Silica Gel
   (xx) IS 3177: Code of practice for Electric overhead travelling cranes and gantry cranes other than steel work cranes
   (xxi) IS 3588: Electric axial fans
   (xxii) IS 3589: Seamless or electrically welded steel pipes for water gas and sewage (168.3 mm to 2032 mm outside diameter)
   (xxiii) IS 3938: Electric wire rope hoists
<table>
<thead>
<tr>
<th>SL NO</th>
<th>TITLE OF THE STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>(xxiv)</td>
<td>IS 4671: Expanded polystyrene for thermal insulation purposes</td>
</tr>
<tr>
<td>(xxv)</td>
<td>IS 4894: Centrifugal fans</td>
</tr>
<tr>
<td>(xxvi)</td>
<td>IS 5111: Code of practice for measurement for testing refrigerant compressor</td>
</tr>
<tr>
<td>(xxvii)</td>
<td>IS 5120: Technical requirements for roto dynamic special purpose pumps</td>
</tr>
<tr>
<td>(xxviii)</td>
<td>IS 5290: Specification for landing valves</td>
</tr>
<tr>
<td>(xxix)</td>
<td>IS 5312: Specification for Swing check type Reflux (Non return) valves for water works purposes – Part –1: Single door Pattern</td>
</tr>
<tr>
<td>(xxx)</td>
<td>IS 7413: Code of practice for application and finishing of thermal industrial application and finishing of thermal insulation</td>
</tr>
<tr>
<td>(xxxi)</td>
<td>IS 7613: Method of testing panel type air filters for air conditioning and ventilation purposes</td>
</tr>
<tr>
<td>(xxxii)</td>
<td>IS 7938: Code for Air receivers</td>
</tr>
<tr>
<td>(xxxiii)</td>
<td>IS 8148: Packaged air conditioners</td>
</tr>
<tr>
<td>(xxxiv)</td>
<td>IS 8154: Pre formed calcium silicate insulation (for temperatures upto 650 Deg C)</td>
</tr>
<tr>
<td>(xxxv)</td>
<td>IS 8183: Bonded mineral wool</td>
</tr>
<tr>
<td>(xxxvi)</td>
<td>IS 13834: Cranes classification.</td>
</tr>
<tr>
<td>(xxxvii)</td>
<td>IS8423: Specification for controlled percolating hose for fire fighting</td>
</tr>
<tr>
<td>(xxxviii)</td>
<td>IS 9137: Code of acceptance test for centrifugal, mixed flow and axial pumps – Class C</td>
</tr>
<tr>
<td>(xxxix)</td>
<td>IS 11989: Code for Air driers</td>
</tr>
<tr>
<td>(xxxx)</td>
<td>IS 14164: Industrial application and finishing of thermal insulation material at temperature above –80 Deg C and upto 700 Deg C – Code of practice</td>
</tr>
<tr>
<td>(xxxxi)</td>
<td>IS 14846: Sluice valve for water works purposes (50 mm to 1200 mm size) – Specification</td>
</tr>
</tbody>
</table>

| 23.0 | Underwriter Laboratories (UL) 555 – Fire dampers |
| 24.0 | Oil Industry Safety Directorate (OISD) |
| 25.0 | American Petroleum Institute |
| a) | API 617: Centrifugal Compressors for Petroleum, Chemical and Gas Service Industry Services |
| b) | API 672: Packaged Integrally Geared Centrifugal Air compressors for Petroleum, Chemical and Gas Industry Services. |

| 26.0 | Chief Inspector of Factories in the State of Gujarat. |
| 27.0 | American Water Works Association (AWWA). |

**NOTE**: The above list of codes and standards is indicative and for the guidance. Codes and standards indicated in the respective sections and data sheets shall also be referred for completeness. Bidder to indicate in his offer any additional list of codes and standards which he deems necessary for the design of his equipment/system.
1.0 **SCOPE**

1.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

2.0 **CODES AND STANDARDS**

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship. The following Indian Standards may be referred to for carrying out the painting job:

- **IS:5**: Colours for ready mixed paints and enamels
- **IS:1303**: Glossary of terms relating to paints
- **IS:2379**: Colour code for identification of pipelines
- **IS:1477**: Code of practice for painting of ferrous metals in buildings (Parts I & II)
- **IS:2524**: Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
- **IS:2395**: Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
- **IS:2338**: Code of practice for finishing of wood and wood based materials (Parts I & II)
- **IS:6278**: Code of practice for white washing and colour washing
- **IS:3140**: Code of practice for painting asbestos cement building products
- **IS:158**: Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting
- **IS:2074**: Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
- **IS:104**: Ready mixed paint, brushing, Zinc Chrome, priming
- **IS:2932**: Enamel, synthetic, exterior (a) undercoating (b) finishing specification.

3.0 **PREPARATION OF SURFACES**

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER/OWNER REPRESENTATIVE. The sheet steel of electrical and instrumentation panels shall be pre-treated through...
chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required the Contractor shall carry out the same to get a smooth finish.

4.0 **PRIMER PAINT**

After the surface is prepared, one coat of Zinc Phosphate primer conforming to IS:2074 shall be applied. After this first coat is dried up completely, second coat of red oxide primer shall be applied. Primer shall be applied by brushing to ensure a continuous film without ‘holidays’. The dry film thickness of each coat shall be minimum 25 microns.

5.0 **FINISH PAINT**

Synthetic enamel paint conforming to IS:2932 shall be used for finish coats. The colour/shade shall be as approved by the ENGINEER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After applying second coat, allowing the water to get evaporated completely, third finish coat of synthetic enamel paint shall be applied. The dry film thickness of each coat shall be minimum 25 microns.

Epoxy painting to be done for trunk conveyor BCN-M4 at LHS, Numbering to be done in all conveyors for all carrying idlers at the interval of every five frames and also for each return idlers frame.

For all electrical equipment, Powder coating shall be done as per relevant standard.

6.0 **SUGGESTED COLOUR CODES FOR PAINTING**

<table>
<thead>
<tr>
<th>SL.NO.</th>
<th>ITEM/SERVICE</th>
<th>COLOUR</th>
<th>IS-5</th>
<th>COLOUR (BAND)</th>
<th>IS-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Structures, platforms, galleries, ladders</td>
<td>Dark Admirality Grey</td>
<td>632</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>and handrails</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Boiler casing, ESP and ducting</td>
<td>Nut Brown</td>
<td>413</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.0</td>
<td>Fans, pumps, motors, compressors</td>
<td>Light Grey</td>
<td>631</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4.0</td>
<td>Tanks (without insulation and cladding)</td>
<td>Light grey</td>
<td>631</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Powder coated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Vessels &amp; all other proprietary equipment</td>
<td>Light grey</td>
<td>631</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(without insulation &amp; cladding)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Switchgear</td>
<td>Light grey</td>
<td>631</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(Powder coated)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>Control &amp; relay panels</td>
<td>Light grey</td>
<td>631/7078</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of IS 1650</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>Turbine</td>
<td>Golden Yellow</td>
<td>356</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9.0</td>
<td>Generator &amp; exciter</td>
<td>Light grey</td>
<td>631</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10.0</td>
<td>Transformers</td>
<td>Light grey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11.0</td>
<td>Machinery guards</td>
<td>Signal red</td>
<td>537</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12.0</td>
<td>Piping (without insulation and cladding)</td>
<td></td>
<td></td>
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</table>
12.1 Water System

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>ITEM/SERVICE</th>
<th>COLOUR</th>
<th>IS-5</th>
<th>COLOUR (BAND)</th>
<th>IS-5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condensate</td>
<td>Sea green</td>
<td>217</td>
<td>Light brown</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td>D M Water</td>
<td>Sea green</td>
<td>217</td>
<td>Light orange</td>
<td>557</td>
</tr>
<tr>
<td></td>
<td>Soft water</td>
<td>Sea green</td>
<td>217</td>
<td>French blue</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Bearing cooling water</td>
<td>Sea green</td>
<td>217</td>
<td>French blue</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Potable &amp; filtered water</td>
<td>Sea green</td>
<td>217</td>
<td>French blue</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Service &amp; clarified water</td>
<td>Sea green</td>
<td>217</td>
<td>French blue</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Raw water</td>
<td>Sea green</td>
<td>217</td>
<td>White</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cooling water</td>
<td>Sea green</td>
<td>217</td>
<td>French blue</td>
<td>166</td>
</tr>
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</table>

12.2 Air System

<table>
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<tr>
<th>SL. NO.</th>
<th>ITEM/SERVICE</th>
<th>COLOUR</th>
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<th>COLOUR (BAND)</th>
<th>IS-5</th>
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<tbody>
<tr>
<td></td>
<td>Station air</td>
<td>Sky blue</td>
<td>101</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Control air</td>
<td>Sky blue</td>
<td>101</td>
<td>White</td>
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12.3 Oil system

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>ITEM/SERVICE</th>
<th>COLOUR</th>
<th>IS-5</th>
<th>COLOUR (BAND)</th>
<th>IS-5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fuel oil</td>
<td>Light brown</td>
<td>410</td>
<td>French blue</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Light oil</td>
<td>Light brown</td>
<td>410</td>
<td>Brilliant green</td>
<td>221</td>
</tr>
<tr>
<td></td>
<td>Lubricating oil</td>
<td>Light brown</td>
<td>410</td>
<td>Light grey</td>
<td>631</td>
</tr>
<tr>
<td></td>
<td>Transformer oil</td>
<td>Light brown</td>
<td>410</td>
<td>Light orange</td>
<td>557</td>
</tr>
</tbody>
</table>

12.4 Gas system

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>ITEM/SERVICE</th>
<th>COLOUR</th>
<th>IS-5</th>
<th>COLOUR (BAND)</th>
<th>IS-5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carbon dioxide</td>
<td>Canary yellow</td>
<td>309</td>
<td>Light grey</td>
<td>631</td>
</tr>
<tr>
<td></td>
<td>Fire services</td>
<td>Fire red</td>
<td>536</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Ash slurry pipes</td>
<td>Black</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Vacuum pipes</td>
<td>Sky blue</td>
<td>101</td>
<td>Black</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Fuel pipes (pulverised coal)</td>
<td>Light brown</td>
<td>410</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Drainage</td>
<td>Black</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
1. This colour code basically refers to IS: 2379 for piping with necessary modifications
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.
3. For any item left out, colour coding will be decided after Owner’s approval.
1.0 LAYOUT REQUIREMENTS

1.1 GENERAL LAYOUT

1.1.1 A preliminary layout of the proposed power plant is shown in the ‘Plot Plan’. The plot plan identifies the relative locations of various facilities within the plot. The Plot Plan also identifies the plant battery limits proposed under this contract.

1.1.2 Modifications on the building dimensions are allowed to the BIDDER subject to the review and approval of Owner / Engineer.

1.1.3 All other buildings dimensions shall be finalised by the BIDDER and subject to the review and approval of Owner / Engineer. Suitable maintenance facilities shall be provided in all buildings.

1.2 PLANT LAYOUT REQUIREMENTS

1.2.1 The steam turbine generator and its auxiliaries shall be located inside the turbine building.

1.2.2 Lay down space required during initial erection and subsequent maintenance or overhaul of an equipment for the various components of turbine generators shall be clearly indicated in the drawings by BIDDER. All these components of turbine as also the rotors of turbine, generator and exciter are intended to be laid down during erection or maintenance on the respective operating floors itself.

1.2.3 In order to prevent any vibration from the steam turbine set from being transmitted to the turbine building and other equipment located inside the building, the STG shall be founded on an independent pedestal, separated from all other foundations and superstructure by adequate clearances all around.

1.2.4 All heavy equipment and heavy rotating machinery in particular as far as possible, should be located on ground floor. Their foundations should be clear of column foundations since such an arrangement will avoid vibrations being transmitted to the building from the rotating machinery.

1.2.5 Space for the rotor withdrawal, cooler tube removal and other areas reserved for such erection or maintenance activities shall be clearly identified in the drawing such that no equipment or piping,
| TITLE | TECHNICAL SPECIFICATION  
|-------|---------------------------------------------------------------|
|       | LIMESTONE HANDLING SYSTEM  
|       | SPECIFIC TECHNICAL REQUIREMENTS  

1.2.6 All skids housing mechanical equipment shall be dimensioned to provide an undisturbed space, free of pipes or similar obstacles of at least 1000 mm between installed equipment and surrounding enclosures or walkways to ensure proper access for maintenance and operation.

1.2.7 In the steam turbine building, hatches should be provided above equipment in the floors when these equipment are expected to be lowered to their permanent positions directly by the main EOT Crane.

1.2.8 Additional hatches should be provided at appropriate locations for lowering all other equipment to their respective floors. Adequate movement paths with requisite headroom should be provided for the movement of all such equipment from these hatches to their respective locations.

1.2.9 As far as possible, equipment layout should follow the logic and sequence of the flow process. This will result in simple and convenient piping layouts. When flow takes place essentially by gravity, receiver vessels should be placed at a lower elevation than the source vessel.

1.2.10 Adequate consideration should be given to the prevention and containment of fire. Necessary accesses shall be provided for the entry of fire fighting personnel in the event of a fire breakout and also for the safe exit of operating personnel.

1.2.11 Care should be taken in developing the layout of equipment handling explosive, hazardous or toxic substances. Such equipment should be preferably housed in separate rooms or enclosures and segregated from other working areas. Such areas shall be adequately ventilated. Adequate measures should be taken to ensure personnel safety.

1.2.12 Noise should be given due consideration in the layout of equipment. When the noise generated by equipment and machinery is expected to be in excess of recommended limits of 85 db A at 1.5m, such machinery should be provided with acoustic hoods or isolated from general working area by locating inside a walled room.

1.2.13 Security aspects should also be borne in mind while finalizing layouts so that entry or encroachments of unauthorized personnel into working area is prevented.

1.2.14 All piping shall be grouped wherever practicable and shall be routed to present a neat appearance. Drains shall be provided at all low points and vents at all high points as per actual layout. All equipment/piping drains shall be led into nearest flash tank/floor drain as applicable.

1.2.15 All necessary auxiliary platforms and access stairways ladders for operation and maintenance of equipment valves, instruments, etc., shall be provided.

1.2.16 As far as possible, pathways shall be straight. A clear head room of minimum 2700 mm shall be provided over pathways (passages) and a minimum of 3000 mm in rooms with false ceiling and finished floor to ceiling vertical headroom shall be 3600 mm.

1.2.17 The number and location of staircases shall be decided by considerations of operation and maintenance and above all from fire escape and fire fighting point of view. The recommendations of Tariff Advisory Committee (TAC) shall be followed while locating staircases from fire exit point of view. Steel type of grating shall be used for treads. Staircases shall have a minimum width of 1000 mm in buildings. Number of staircases are subject to the approval of Owner/Engineer.

1.2.18 For access to the catwalks of existing EOT crane, a cage ladder shall be provided at either end of each catwalk. These ladders shall be provided from operating floor to suit layout.
### SPECIFIC TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Requirement</th>
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</thead>
<tbody>
<tr>
<td>1.2.19</td>
<td>Access space of a minimum of 1000 mm shall be provided all round the equipment. Space shall be provided for withdrawal and placement of generator on the operating floor.</td>
</tr>
<tr>
<td>1.2.20</td>
<td>Space for condenser tube removal shall be provided at one end of the condenser. No permanent equipment, structure, piping or cabling shall be placed within tube removal space. However, temporary removable platforms may be provided as per the requirements of the layout so that during normal operation, maintenance personnel can approach the manhole covers of the condenser water boxes. Space shall be allocated for complete opening of the hinged waterbox covers, so that after opening, they stand clear of the condenser tube removal space.</td>
</tr>
<tr>
<td>1.2.21</td>
<td>Pipe trenches for essential systems like condensate suction piping may be provided. If trench is provided, access to pump suction strainers and expansion joint shall be ensured and the trench width shall be adequate to enable assembly and dis-assembly of flange joints. While finalising the trenches, a minimum space of 300 mm shall be provided from the outer face of pipe. Clear space of 150 mm shall be provided below the pipe support for easy drainage.</td>
</tr>
<tr>
<td>1.2.22</td>
<td>Openings should be sufficient to permit movement of pipes from cold to hottest condition.</td>
</tr>
<tr>
<td>1.2.23</td>
<td>Access openings should be provided with removable gratings or chequered plates. For those access, openings which are not provided with chequered plates, hand railing should be provided all around the access opening. CONTRACTOR may optimise the layout of the building subject to constraints specified.</td>
</tr>
<tr>
<td>1.2.24</td>
<td>The overall dimensions of the station building and all other buildings given in these sketches are considered minimum to be adopted by the CONTRACTOR. However, in the opinion of the CONTRACTOR, if these dimensions need to be increased, the same is acceptable subject to approval of OWNER/Engineer.</td>
</tr>
<tr>
<td>1.2.25</td>
<td>The feed water pumps shall be located in the TG building and the deaerator shall be located on the roof of this building outdoor. Necessary handling arrangement for pumps, motors, gear boxes, suction strainers, etc., shall be provided.</td>
</tr>
<tr>
<td>1.2.26</td>
<td>The fuel oil forwarding pumps shall be located inside the pump house (existing).</td>
</tr>
<tr>
<td>1.2.27</td>
<td>The bottom base frames of all equipment shall be 300 mm above the respective floor or grade level.</td>
</tr>
<tr>
<td>1.2.28</td>
<td>Location of fuel oil pumps shall be based on the level of the existing tanks and provision of direct suction pipe layout to ensure adequate NPSH of pumps.</td>
</tr>
<tr>
<td>1.2.29</td>
<td>The location of deaerator shall be decided considering the net positive suction head (NPSH) requirements of the feed water pumps under worst operating conditions and with adequate margin as specified. Particular care to be taken for the operation of the feed pumps under frequency lower than the normal.</td>
</tr>
<tr>
<td>1.2.30</td>
<td>All other pumps should also be laid considering the NPSH requirements as stated above.</td>
</tr>
<tr>
<td>1.2.31</td>
<td>Operation and maintenance of sumps should be provided with rung ladders.</td>
</tr>
<tr>
<td>1.2.32</td>
<td>Ladder may be provided up to a maximum height of 3.0 m. Beyond this height, access through stairways shall be provided. Under exceptional circumstances cage ladder can be provided for height beyond 3.0 m if there is no feasibility of providing stairways. Such cases should be subject to prior approval by Owner / Engineer.</td>
</tr>
</tbody>
</table>
### SPECIFIC TECHNICAL REQUIREMENTS

| **1.2.33** | The stack shall be provided with a staircase and lift up to the full height of stack. Suitable insulation for flue as required shall also be provided. At the elevation in stacks where sampling probes have to be installed for stack gas monitoring suitable platforms with suitable access have to be provided. Also, at locations where aviation lighting or lightning arrestors are provided, suitable platforms with access have to be provided. |
| **1.2.34** | In laying out the equipment all necessary statutory requirements should be complied with by the CONTRACTOR. |
| **1.2.35** | The layout of equipment in the areas where fuels or other hazardous substances are handled, the layout conforming to the relevant codes and standards shall be provided. The classification of hazardous areas and selection of electrical equipment in such areas shall be based on established codes and standards as well as prudent engineering practices. Necessary statutory approvals for this purpose shall be obtained by the CONTRACTOR. |
| **1.2.36** | Wherever equipment have to be removed from buildings, rolling shutters of suitable size or easily removable doors shall be provided. |
| **1.2.37** | In transformer yard and around fuel oil pumps, a separate drain system shall be provided to carry oil mixed water. This drain system shall not be connected to the storm water drains network. |
| **1.2.38** | The travel length of every crane shall necessarily extend to a minimum of 2 meters beyond the foundation of the equipment required to be handled. Proper crane hook approach shall be ensured. |

### 1 & C LAYOUT REQUIREMENTS

| **1.3.1** | Unit Control Desk (UCD) and Unit Control Panel (UCP) (common for I &C and Electrical) shall be installed in the control room and all system cabinets, terminal and other cabinets and distribution boards shall be installed in the electronic cubicle room of the control room. |
| **1.3.2** | All the cabinets shall have the same height, depth and colour. The CONTRACTOR shall submit a control room layout drawing clearly indicating all the dimensions of the control panels / desks, system cabinets, marshalling cabinets, doors, knockout doors, floor opening required for cable entry, etc. |
| **1.3.3** | Electronic grounding for Plant DCS and Utility PLCs shall be separate from station grounding. |
| **1.3.4** | Any specific recommendation regarding the location and limiting distances between the different equipment to be located in the control room and in the annexe of the control room shall be detailed and the layout for the same shall be furnished during detailed engineering stage for Owner’s / Owner’s Representative approval. |
| **1.3.5** | Annunciator facia windows shall be located on the UCP. |
| **1.3.6** | The location of transmitter enclosures / field instrument enclosures / junction boxes shall be designed depending on the equipment / tapping point location. The number of transmitters to be housed in each transmitter enclosure shall be limited to five. However, OWNER reserves the right to change the number of transmitters to be housed in each transmitter enclosure and to increase or decrease the total number of transmitter enclosures at site. |
| **1.3.7** | The exact routing of impulse pipes / tubes will be decided at site during erection depending upon the location of tap points and location of transmitter enclosures. OWNER reserves the right to approve the suitable location of the transmitter enclosures and field mounted junction boxes. All platforms required for mounting and accessing the transmitter racks shall be provided as required. |
| **1.3.8** | All I&C equipment being supplied by the CONTRACTOR shall be supported adequately to prevent vibration and anchored sufficiently to prevent undue strains on the equipment served. Hangers and
supports shall be so installed as not to interfere with free expansion and contraction of the piping and tubing between anchors. Suitable spring hangers, vibration dampers, etc., shall be provided wherever necessary. In addition, care should be taken that the arrangement of piping, tubing, cable trays and supports provide for safety under working stress and shall protect the piping and tubing from detrimental sagging, mechanical injury, abuse to unusual service conditions from sources other than those due to pressure, temperature and vibrations.

1.3.9 Straight length requirement before and after control valves, flow element and desuperheater shall be provided as per applicable standard codes.

1.3.10 The tapping point instruments shall be located at appropriate location to meet the purpose of the instrument provided for. e.g., the pressure switch to open a discharge valve of a centrifugal pumps after a pump start shall be located between pump and discharge valve; the temperature sensing at a desuperheater outlet for temperature control shall be located after a straight length to ensure through mixing of the fluids and temperature is measured at a location of laminar flow.

1.3.11 The minimum I&C System requirements are specified in respective section and also specified at Section-16. However, Contractor shall supply the required system/instruments to meet the process/Plant requirements.

1.4 ELECTRICAL LAYOUT REQUIREMENTS

1.4.1 Unit Control Panel (UCP) (Common for Electrical and I &C) and I&C system cabinets shall be located in the control room. Cabling for these panels shall be through the cable vault of adequate height. Cable trays shall be provided in the cable vault for the panels located in control room. Also, refer Section 15.0.

1.4.2 Separate rooms shall be provided for batteries. The battery charger and UPS equipment shall be located adjacent to battery room. The battery room shall have space provision for wash basin and accessory storage. 110 V AC UPS and battery shall be located adjacent to control room.

1.4.3 Switchgear room for the fuel oil pump house MCC shall meet the fire safety requirements.

1.4.4 All the rooms housing the electrical panels shall have minimum 2 nos. fire proof doors opening outside.

1.4.5 Access to the rooms and doors provided in various floors shall consider movement of panels during erection and also later during maintenance/ replacement.

1.4.6 The layout shall meet all the statutory requirements, Tariff Advisory Committee regulations and electrical inspectorate requirements.

1.4.7 General requirements for all Layouts

The layout of the switchboard shall consider the following aspects.

a. Adequate space for movement of personnel with breaker/modules withdrawn.

b. Adequate movement & operation space around

c. Separate maintenance space

d. Space for cable trenches / racks. All the cable shall be laid in trench / racks only.

e. Minimum statutory clearance requirements

f. Space for additional panels that may arise during engineering and O&M.

1.4.8 Following shall be considered as minimum spacing (after considering space for future extension) for various switchboard.
(a) 6.6kV switchgear facing 415V switchboard  2500 (min)
(b) Two 415V switchboard or panels facing each other  2000 mm (main switchboard), 1500mm (battery chargers, LDB, UPS, etc.)
(c) LV switchboard or panel front facing the wall  2000 mm (main switchboard), 1500mm (battery chargers, LDB, UPS, etc.)
(d) LV switchboard / panels back side to the obstructions like column, raceways, walls if single front  1000 mm or door opening space plus personnel movement whichever is higher
(e) Space between the sides of two switchboard panels or switchboard panels and the wall.  1000 mm
(f) From top of switchboard / panels to nearest obstruction  800 mm (min).
(g) Between battery banks and battery bank to any obstruction / wall.  2000 mm

1.4.9 Transformer Yard Layout
(a) The location of the transformer shall consider at least 1.25m spacing around the equipment.
(b) Between two transformers, fire proof walls extending up to 600mm beyond the transformer’s outer periphery on all sides and top shall be provided as per the requirements of TAC.

1.4.10 Oil soak pit filled with river pebbles shall be provided below the transformers extending beyond the outer periphery. Separate oil collection pit (burnt oil pit) shall be provided away from the transformers to which the soak pits shall be connected by straight pipes.

1.4.11 The capacity of the soak pit in its void space shall be at least 1/3 of the total volume of the oil in the transformer. The burnt oil pit shall have the capacity of containing 110% of the total oil volume of the largest transformer.

1.4.12 The transformer yard shall be fenced and provided with gates at convenient points for movement of personnel. The transformer yard and switch yard shall be in line with existing layout.

1.5 GENERAL REQUIREMENTS

1.5.1 Ramps having a slope of 1:8 shall be provided in front of all doors provided with rolling shutters.

1.5.2 The general requirements like toilets, pantry, staircase, etc., shall be provided in all the buildings, as applicable.

1.5.3 Based on the above, Bidder shall furnish the layout of the buildings for review by Owner / Owner’s Representatives.
1.5.4 Each building and each floor of the building shall be provided with separate toilets for men and women.

1.5.5 Furniture & Furnishing for all control room.

1.5.6 Green belt development.

1.6 MAINTENANCE REQUIREMENTS

1.6.1 The CONTRACTOR shall provide necessary equipment including cranes and hoists, tools and tackles, lifting equipment, etc. as required for the maintenance of the equipment provided under this Contract even though the same may not be explicitly stated in the specification. Such maintenance equipment and tools and tackles are deemed to be included irrespective of whether the same have been specified or not.

1.6.2 Necessary mobile maintenance and access ladders shall be provided for access to roof of buildings not provided with staircase or for maintenance of inaccessible equipment (for e.g. light fittings).

1.6.3 Other mobile maintenance equipment such as hoists and chain pulley blocks, tripods and other tools as required for regular maintenance of plant shall be provided by CONTRACTOR.

1.7 I & C MAINTENANCE REQUIREMENTS

1.7.1 All equipment furnished by CONTRACTOR shall be designed for ease of maintenance to help achieve a high meantime between failures (MTBF). All equipment shall be of modular design to assure a short mean time to repair (MTTR).

1.7.2 The following specific provisions shall be made to achieve the above objective:

(a) The CONTRACTOR shall furnish the details of the maintenance requirements of each equipment, indicating list of parts which require regular maintenance and frequency of maintenance for these parts. Based on CONTRACTOR's experience, documentation giving a recommended maintenance program to achieve a high MTBF for the system shall be furnished.

(b) The CONTRACTOR shall furnish sufficient documentation to ensure efficient maintenance and trouble-shooting of equipment and modules. This shall include point to point wiring diagrams and schematic diagrams of all electronic assemblies supplemented with concise description of theory of operation of individual subsystems. Expected faults, trouble shooting hints, check-out lists and a list of sub-components prone to failure shall also be provided.

(c) All equipment shall have extensive self-diagnostic features, test points and clearly labelled error indicating lamps which help in speedy identification of faulty modules.

(d) Provision shall be made for isolation sub-systems / modules which are identified to be faulty, thus enabling on-line replacement without taking equipment off-line.

(e) Adequate number of test equipment, test sockets, test cables, digital voltmeters, signal generators, card extenders, maintenance equipment tools, special erection tools, etc., shall be provided by the CONTRACTOR to facilitate ease in maintenance and to have minimum down time.

(f) Components of same function shall be as far as possible interchangeable.

(g) Standardisation concept shall be used in setting the components for the systems.
Appendix – 5

Pollution Control requirements

1.0 GENERAL

The Contractor shall offer a plant so as to meet the pollution control requirements of statutory authorities. Emissions and discharges of solid, liquid and gaseous effluents from the Thermal Power Plant shall fully comply with all requirements and limits specified in Environmental (Protection) Act, 1986, Minimum National Standards (MINAS), along with all latest amendments to all of the above requirements, stipulations of the Central Pollution Control Board (CPCB), Ministry of Environment and Forests (MOEF) and State Pollution Control Board (SPCB) for the project, and any other central or local statutory requirements regarding environmental pollution and its abatement.

The Contractor shall be responsible for obtaining all necessary approvals, licenses and permissions, which are related to design, construction, installation and operation of the plant. These shall be obtained at appropriate time to ensure that the construction and commissioning programme can be realised.

2.0 GASEOUS AND PARTICULATE EMISSIONS

For the complete range of fuels specified, including fuel oil, the gaseous and particulate emission from the stack shall comply with the requirements stipulated by statutory authorities.

The Contractor shall provide continuous monitoring equipment to measure particulate matter (e.g. cross-stack optical density or equivalent), carbon monoxide, sulphur dioxide, nitrogen oxides, and temperature of the stack gases. The monitoring instruments must be carefully located to ensure that representative sampling is obtained and sampling should be to a recognised standard.

The monitoring systems should incorporate the means to record various time-averaged values as required by the performance requirements. Monitoring data should be displayed in the control room, with provision of alarms to notify the operator of any deviation from the specified values. The Contractor shall furnish a list of monitoring equipment he intends to provide with their location in the plant.
3.0 DUST CONTROL

Dust emission to the air from the site, including lignite stacking area, lignite transfer points, unloading from fly ash silo, dry fly ash disposal area, roadway, etc. shall be controlled by providing suitable dust control systems.

4.0 NOISE CONTROL

4.1 An integrated approach shall be taken by the Contractor to control noise emission which shall include but not be limited to:

(a) Design and layout of building to minimise transmission of noise, segregation of particular items of plant and to avoid reverberant areas.

(b) Specification of permissible noise levels for bought-out items.

(c) Choice of materials for civil construction

(d) Acoustic design of building for blower rooms and DG house.

(e) Use of lagging with attenuation properties on plant components / installation of sound attenuation panels around the equipment.

4.1.1 Where the requirements stated above are not met within the basic design of the plant they shall be achieved by suitable means of noise control, which shall conform to the following requirements:

(a) The noise control system shall, as far as possible, be designed to form an integral part of the plant.

(b) The abatement system shall, wherever practicable, be applied to the source of excessive noise rather than to the entire item or component.

(c) If above means are not adequate and enclosures are used for noise abatement, close-fitting enclosures shall be provided.

4.3 NOISE IN CONTROL AREAS

(a) Control Rooms

The noise levels in control rooms must be such that intelligible speech communication is always possible and mental concentration is not hindered.

(b) Other Control Areas

The noise levels in other control areas must be such that intelligible conversation (telephone and person-to-person) is possible and operator fatigue is minimised.

(c) Station Noise Criterion

The criterion for environmental noise is that the design of the station and its components shall not exceed, in any continuous mode of operation, the level stipulated by MOEF and/or Pollution Control Board at any point on the site boundary. Presently the norm is such that the noise level shall not exceed 85 dBA at 1.5 m from the equipment surface and 50 dBA at the plant boundary.

5.0 DISCHARGE OF LIQUID EFFLUENTS
Clear water drains and cooling tower blow down, shall be led to the guard pond and after dilution for 12 hours, overflow water shall be led to natural nala through drains. The final effluent before discharge into the nullah will confirm to the tolerance limits stipulated by the pollution control board.

6.0 RECOMMENDED SYSTEMS FOR TREATMENT OF DIFFERENT LIQUID EFFLUENTS ARE GIVEN BELOW:

(a) Lignite Handling Plant Waste

Waste water from lignite handling plant area including lignite stock area shall be led to lignite runoff pond of adequate storage capacity located near the lignite stock pile. This water shall be treated in existing clarifier and treated water led to drains or reused.

(b) DM Regeneration Waste

Regeneration waste be collected and treated in neutralising pit and shall be discharged to guard pond. Gurad pond water shall be reused for plant washing and gardening.

(c) Miscellaneous Plant Waste

Waste from TG area boiler area and oily waste from oil tank farm area be treated in an oil water separator & the clear effluent shall be led to guard pond. Separated oil shall be disposed manually.

(d) Sanitary Waste

The sanitary waste shall be collected in respective sceptic tanks and sock pits.

7.0 TREATMENT OF BOILER CLEANING EFFLUENT

To take care of the effluents generated due to chemical cleaning of boiler and auxiliaries during precommissioning and post commissioning stages, an impervious solar pond will have to be provided having adequate size to facilitate retrieval of the solids and disposal of the same in environment friendly manner.

8.0 MONITORING REQUIREMENTS

The Contractor shall include continuous monitoring equipment for the following as minimum.

(a) Continuous monitoring system for suspended particulate matter, SO2, NOx and CO as per section-16.

(b) For manual monitoring of ambient air quality – High Volume Sampler with attachment for gaseous sampling and respirable particulate matter sampler – four (4) sets (minimum)

(c) Stack monitoring kit complete with all accessories as well as NOx sampling assembly for manual monitoring of stack gases conforming to the requirements laid down by CPCB.

(d) One completely automatic micro-meteorological data collection and station comprising wind-vane, anemometer, thermometer, hygrometer, sunshine recorder, evaporimeter, rain-fall recorder etc. The stations shall be equipped with arrangement for measurement of ground based inversions using techno-commercially acceptable methods. Alternative means can be proposed for the method of measurement of inversions on hourly basis.

All the signals of the system shall be connected to Plant DCS for the monitoring.
(e) On line monitoring equipment for continuous monitoring of temperature and other salient parameters like TSS, free chlorine, pH, oil and grease, and heavy metals of treated effluent before reuse shall be provided.

(f) All monitoring equipment shall be handed over to the client/Owner after commissioning.

1.0 PERFORMANCE GUARANTEES

Performance guarantee parameters shall be as per ‘Schedule of Performance Guarantees’ and guarantees listed below.

2.0 GUARANTEES UNDER CORRECTION

2.1 Emission level at stack and vent filters provided on product hoppers and limestone bunkers.

2.2 Plant capability

(a) Noise level both from individual noise generating sources and at plant boundary
(b) Vibration level
(c) Surface temperature of thermal insulation

2.3 Guaranteed losses/ Temperature rise for all electrical equipment.

3.0 LIQUIDATED DAMAGES FOR PERFORMANCE

3.1 Should the performance test results during the ‘Performance guarantee Tests’ deviate from the guaranteed values as indicated in the Schedule of Performance Guarantees, the CONTRACTOR shall correct the equipment at his own expense and repeat the performance tests within a reasonable period of time to be mutually agreed between OWNER and CONTRACTOR. In case of unremedied shortfall in guaranteed performance parameters of those items under liquidated damages, the CONTRACTOR shall be liable to pay the OWNER by way of liquidated damages for performance shortfall as stipulated below:

- For every kW increase in auxiliary power consumption: Rs. 2.00 lakhs or project specific
3.2 Should the combined liquidated damages for performance exceed 10% of the contract value OWNER reserves the right to reject the plant. In case such an option of rejection is being exercised, the CONTRACTOR shall replace the equipment with one, which shall meet the guaranteed values.

4.0 OTHER PLANT ACCEPTANCE LIMITS

Contractor shall guarantee Pollution Norms 'under correction' as per Clause No. 5.0 of Section 18.3. In case of Performance shortfalls, the Contractor would be given opportunity to make good such shortfall by suitable remedial action. Thereafter, if the Contractor is unable to restore the performance shortfall, the Owner may reject the plant. In case the rejection option is exercised by Owner, the Contractor shall replace the plant with one that meets the guaranteed values without any cost to the Owner.

5.0 PERFORMANCE ‘UNDER CORRECTION’

In respect of items guaranteed ‘under correction’ excluding Cl. No. 2.0 above, the Contractor shall make every effort practicable to correct the deficiencies. In case the Contractor fails to meet the guarantees, the equipment / system is liable to be rejected and in case of such an option, the Contractor shall replace the equipment with one that shall meet the guaranteed values without any cost to the OWNER.

6.0 AVAILABILITY REQUIREMENTS

6.1 Though the unit’s life is 30 years, some equipment / components may have shorter life. BIDDER shall indicate the expected life of those equipment / components.

6.2 Not withstanding the above, the BIDDER shall offer his equipment / systems satisfying the following criterion:

(a) All equipment and systems shall be of proven design, using materials established as appropriate to the service intended. The fabrication / manufacturing processes shall be subject to quality surveillance and tests as specified.

(b) All standby auxiliaries shall be designed for automatic start-up in the event of failure of the operating auxiliaries.

(c) To ensure high reliability and availability of the instrumentation and control system the following measures shall be taken by the VENDOR:

(i) Shall be designed with extensive self-diagnostics and trouble shooting features. Adequate facilities shall be provided for quick repair / maintenance and on-line replacement of faulty modules. This shall not result in spurious trips. Where a major equipment / unit trip is likely to be inhibited when the card is pulled out, it shall be identified by VENDOR during detailed engineering stage.

(ii) Components used in the equipment and systems shall be designed with next higher rating than required for the normal operating conditions in order to have higher availability of the system.

(iii) All control valves / regulating dampers shall have fail-safe protection.

(iv) All components shall be subjected to a burn-in test before they are assembled. Completely assembled shall be subjected to a continuous working test. This test will help in eliminating the weak components in the system, thus increasing reliability and availability.

7.0 SOUND PRESSURE LEVELS INSIDE POWER PLANT AREA
7.1 The individual machines / components / system shall be acoustically designed for a surface sound pressure level of $L_p < 85 \text{ dB (A)}$, measured in accordance with ISO 3746 respectively at a distance of 1 m from equipment surface and at a height of 1.5 m above ground level. The surface sound pressure level ($L_p$) shall be averaged over the measurement surface and corrected for effect of background noise and the influence of reflected sound at measurement surface (environmental correction). With sound pressure levels of 80 dB (A) or less according ISO it shall be ensured that maximum surface noise levels of any item of plant of less than 85 dB (A) at 1.5 m from outline and a height of 1.5 m from the floor shall be net during normal operating conditions.

7.2 SOUND PRESSURE LEVELS IN THE ENVIRONMENT

The power station shall be acoustically designed so that an admissible sound pressure level of 70 dB (A) during night time 22:00 hrs to 6:00 hrs at power plant boundaries. During day time sound pressure levels of 75 dB (A) at above mentioned locations shall not be exceeded during normal operating modes and operation of emergency DG set. These sound pressure levels shall not be exceeded during start-up and shut down and during by pass operation also. Noise may be exceeded during safety valve blowing.

GUARANTEES AND LIQUIDATED DAMAGES (in addition to above)

1 Guarantees: The performance and guarantee test shall be conducted in accordance with the conditions specified in General Technical conditions, and in this section. The parameters guaranteed by the Bidder shall have no tolerance value whatsoever.

The equipment and systems offered under this specification shall be guaranteed to meet the following performance.

(a) Limestone handling system shall be guaranteed for continuous conveying of powdered limestone to feed proposed bunker without any stagnation. The limestone handling system and equipment shall perform satisfactorily to meet the guarantee requirements specified in the following chapter and also those specified in this specification. After the Limestone handling system is ready, the same shall be tested at rated capacity within six (6) months from the date of trial operation preferably during the monsoon season to prove the performance of the system and equipment. The capacity figures specified for the equipment shall have to be achieved with tolerance on the positive side. The guarantee requirements shall be met without undue vibrations in the conveyor supports, junction towers, etc.

(i) Continuous effective conveying of raw limestone from limestone stockyard to raw limestone bunkers in limestone milling area at guaranteed rated conveying capacity.

(ii) Power consumption (KW) as measured at motor input terminals for equipment/items listed in Annexure –1 operating during continuously at rated capacity for guaranteed conveying rate as outlined in Section –C.

(b) Limestone Milling System shall be guaranteed to meet the following performance.

(i) Continuous milling, segregation & classification of powdered limestone at guaranteed design capacity.
(ii) Guaranteed powdered limestone output size in line with sieve analysis (as per Section – C) with mill running continuously at guaranteed rated rate.

(ii) Power consumption (KW) as measured at motor input terminals for equipment/items listed in Annexure –1 operating during continuously at rated capacity for guaranteed milling rate as outlined in Section –C.

(c) Limestone Conveying System shall be guaranteed to meet the following performance

(ii) Continuous effective conveying of powdered limestone from product hoppers to powdered limestone bunkers in boiler area of existing as well as proposed units at guaranteed rated conveying capacity.

(ii) The continuous effective conveying as stated above shall be established by no stagnation of powdered limestone at any point in the complete system and with all interlocks, protections and sequential operation working satisfactorily.

(iii) Power consumption (KW) of air compressors as applicable, as measured at motor terminals when operating at the rated capacity and pressure (only applicable in case additional compressors) are provided.

(iv) The performance listed in b (iii) above shall be performed on test rig at the vendor’s works and actual motor shall be used for this purpose.

( c) Consumption of following

(i) HFO required for Hot air generator (kg/hr)

(d) The value of the various performance guarantee parameters stated above shall be as per the requirements specified in the equipment specifications. Where not specified, these shall be as per guarantees furnished by the Bidder.

1.1 Other system guarantees:

- Dust level at bag filters at product hoppers roof top, limestone bunker top & stack outlet to be guaranteed to 50 mg/NM 3
- Noise and vibration measurement shall be guaranteed within limits indicated in this section or general technical requirements of this specification.

In addition to above shop and site tests, the test requirement specified in subsequent section for Mechanical, Electrical, Civil and Structural items shall also be complied with by the bidder.

2 Liquidated Damages

2.1 The total power consumption for the complete limestone handling plant shall be worked out by using the following formula:

\[ P = (p \times n \times f) \]

\[ P = \text{Total power consumption.} \]
p = Power consumption of the Individual drives listed below (in Annexure-1), at motor input terminals without any negative tolerance

n = No. of drives in operation

f = Duty Factor, which in this case is “1”

The guaranteed power consumption for the package shall be worked out by using the guaranteed 'P' value indicated by the Bidder in relevant Schedule (Guarantee Declaration Schedule) of 'Bid Proposal Sheets' in the enclosed annexure – I.

The actual power consumption for the package shall be worked out by using the measured 'P' value during PG tests (at shop or site as the case may be).

3.0 Vibration level of equipments at bearings shall not exceed the following limits for different equipment. Vibration levels shall conform to the limits specified below and shall be measured as per VDI 2056 / BS 4675.

At the bearing of drive pulley, motor and gear box for the following equipment:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Peak to peak limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii) All other equipment / conveyors / feeders etc.</td>
<td>: 75 microns</td>
</tr>
<tr>
<td>iii) Secondary crushers</td>
<td>: 160 microns</td>
</tr>
<tr>
<td>iv) Travelling tripper</td>
<td>: 100 microns</td>
</tr>
<tr>
<td>v) Compressor</td>
<td>: As per zones A &amp; B of ISO</td>
</tr>
<tr>
<td>vi) On the floors and columns of JT's, and conveyor gallery walkways</td>
<td>200 microns</td>
</tr>
</tbody>
</table>

3.1 Flow of limestone in the transfer chutes and bunkers shall be smooth without any plugging / rat holing even with worst moisture and fines content.

3.2 Illumination Levels

Minimum illumination levels specified for lighting in the Electrical specification shall be achieved during normal operation of the plant with dust laden environment.

3.3 Earthing Resistance

An earthing resistance of less than 1 ohm shall be achieved when measured after isolating lignite & limestone handling system earthing system.

3.4 Endurance Test

Each stream and each path shall be tested at rated capacity for 24 hours to prove that the system functions satisfactorily without any trip due to overload or system fault.

PRE-OPERATIONAL TESTING/STARTUP PERFORMANCE TESTING AND ACCEPTANCE PROCEDURES

1.0 MECHANICAL COMPLETION

1.1 Mechanical Completion is defined as the state of readiness of Works under the scope of Contract to undergo the pre-commissioning checks, followed immediately thereafter by commissioning including Preliminary Operation, Initial Operation, Reliability Operation, Performance Tests including Unit Characteristics Tests for functional or operational occupation of the Works.

1.2 Mechanical Completion shall be deemed to occur when the erection/installation/construction
Works are completed as per Specifications with all equipment / system including standby-

(a) All installation/erection checks duly carried out,

(b) All defects/deficiencies notified by ENGINEER/OWNER during installation/erection rectified to the satisfaction of ENGINEER/OWNER save those, in the opinion of ENGINEER/OWNER, will not affect the safe operability and maintainability of the Works, and

(c) the Contract Works, in the opinion of ENGINEER/OWNER, subject to sub-clause (b) above, being fit, sound, safe and operable for undertaking the pre-commissioning checks, Preliminary Operation, Initial Operation, Reliability Operation and Performance Tests including Unit Characteristics Tests followed by subsequent commercial operation without interruption for reason of defect/deficiency or unfulfilled obligations of the CONTRACTOR in the erection/installation work.

2.0 SPECIFIC REQUIREMENTS OF MECHANICAL COMPLETION

2.1 Mechanical completion in different disciplines shall be determined based on the following characteristics, signifying the readiness of the Works/Plants and Systems for undertaking the pre-commissioning/commissioning checks and subsequent Preliminary Operation, Initial Operation, Reliability Operation and Performance Tests including Unit Characteristics Tests as applicable to the Contract Works:

(a) All plant construction/installation in various disciplines, as detailed under (c) below and as applicable to the Contract are completed including aesthetic and workmanship aspects, with all installation/construction checks as per Specification, relevant Codes, Standards and practices ensuring conformity to Contract and meeting any applicable statutory requirements.

(b) All contractual obligations up to the stage of completion of construction/ installation are fulfilled to the satisfaction of ENGINEER or OWNER.

(c) All Contract Works are otherwise ready to be taken into service, or for functional or operational occupation save pre-commissioning/commissioning checks, Preliminary Operation, Initial Operation, Reliability Operation, Performance Tests, Unit Characteristics Tests including but not limited to the following:

i) Areas inclusive of all roads, accesses, structures, housings, platforms, walkways, stairs, ladders, safety/protective guards, covers, hand rails and such items of work are constructed as per Specification and approved for use

ii) Drains, sewers, waste disposal channels, vents, chutes, ducts and such works are constructed and connected to treatment and other disposal systems

iii) Equipment and piping in different systems/disciplines with all appurtenances, auxiliaries and accessories along with supporting structures, hangers, mounts, etc. are erected/installed, supported, anchored, aligned, grouted and adjusted for operating conditions

iv) Electrical power supply, control, communication and lighting equipment along with control panels, control desks, switchgear, local starters and such accessories along with protective systems, interlocks and integral and auxiliary systems are permanently installed, aligned and adjusted, with megger, continuity and specified
installation checks duly carried out

v) Cables are laid, routed, supported, dressed, clamped, tagged, ferruled and terminated with clamp terminals designated and all continuity and megger checks duly carried out

viii) Safety/relief valves are calibrated and set to operating conditions and tried out. All safety systems are installed, calibrated, checked and accepted

ix) Specified pressure/vacuum/leak/NDT checks for acceptance and any heat treatment are carried out on plant equipment and piping

x) Cleaning including chemical cleaning, flushing, draining and drying are completed

xi) Plant identification numbers, colour codes, tags, name plates are duly mounted/painted/affixed

xii) All painting, lining and insulation works are completed with specified checks to the satisfaction of OWNER/ENGINEER.

3.0 OTHER PREREQUISITES FOR MECHANICAL COMPLETION

3.1 CONTRACTOR shall also meet the following prerequisites for Mechanical Completion:

(a) Submit a compilation of all reports of shop tests, material tests and various stage inspection establishing total compliance to Contract Specification in manufacturing items of supply of Contract

(b) Submission of a certificate by CONTRACTOR in a format agreed with the OWNER that the Contract Works have been designed, selected, manufactured, furnished and installed under the full responsibility of CONTRACTOR

(c) All erected plants, structures, equipment and systems are maintained and preserved in sound condition and are fit and sound to undertake pre-commissioning checks and ‘Tests before Commercial Operation’ for operational and functional occupation immediately thereafter

(d) All areas and constructed works are cleared of all construction materials, temporary works, debris, rubbish water and all such impediments to render the Contract Works safe, sound and operable

(e) All safety features and safety equipment are functional

(f) Any specific statutory approvals pre-requisite to commissioning of the plant are duly obtained.

4.0 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES

4.1 On successful completion of erection, equipment will be subjected to pre commissioning tests. In this connection the Contractor shall carry out the following:

(a) Hydro test

(b) Water flushing and lube oil flushing
(c) Refectory Dry out

(d) Pre-commissioning checks, individuals loop checks, power initialization, verification of system functioning, trouble shooting final solutions to application and / or instrument problems, etc., is Contractor's responsibility. All the required software and hardware changes shall be incorporated as required for successful commissioning to Owner's satisfaction.

(e) Any other tests as may be directed by the Owner/Owner’s Representative.

4.2 Necessary equipment such as hydrotest pump, materials such as gaskets, miscellaneous fasteners, test gauges, etc., tools and tackles including test pressure gauges etc. are to be provided by the Contractor. Any miscellaneous piping, etc., required for completing the tests shall also be provided by the Contractor. Traceable standard instruments shall be used for calibration.

4.3 Any leaky joints noticed during the hydrotest shall be cut, repaired and re welded as directed and tests shall be repeated until satisfactory results are obtained.

4.10 INSTRUMENTATION AND CONTROL, ERECTION, FIELD TESTING AND COMMISSIONING REQUIREMENTS

4.10.1 Erection requirements

(a) The actual location of transmitter racks, junction boxes and other instruments shall be decided by the Contractor depending on the site conditions considering the layout and maintenance aspects.

(b) The Contractor shall get prior approval as per approved quality assurance plan of the Owner / Owner’s Representative before any installation work starts. If any work is carried out by the Contractor before prior approval from Owner / Owner’s Representative and modification is sought by Owner / Owner’s Representative later, then the work will be redone by Contractor without any cost / material implications to the Owner / Owner’s Representative.

(c) Impulse / sample piping, air supply and pneumatic tubing, cable trays and equipment shall be supported rigid enough to prevent vibration and anchored sufficiently to prevent strains on equipment installed. Supporting clamps shall be provided at least at every one metre distance for better rigidity. Impulse / sampling piping shall be provided with adequate slope, (preferably 1:10). Hanger and supports shall be so installed as not to interfere with free expansion and contraction of the piping and tubing between anchors. Suitable vibration dampeners, etc., shall be provided wherever necessary. In addition, care should be taken that the arrangement of impulse / sampling piping, air supply and pneumatic tubing from detrimental sagging, mechanical injury, abuse due to unusual service conditions from sources other than those due to pressure, temperature and vibrations. All impulse lines of joints shall be welded type unless otherwise specified. Argon arc welding shall be employed.

(d) All the panels, desk, cabinets supplied by the Contractor shall be welded or bolted to the floor channel.

4.10.2 Testing requirements

(a) The Contractor shall set up his own instrument laboratory. The calibration equipment shall cover complete range and shall have the desired accuracy of not less than 0.1%. All the
calibration equipment shall have the certification from National Physical Laboratory (NPL) or ‘IDEMI’ for the duration of Contract Period.

(b) The Contractor shall follow the standard procedures for calibration of various instruments and as set by the manufacturer of instruments and as instructed by the Owner including any requirements of field calibration. First, the calibrations shall be carried out independently by the Contractor and later in the presence of Owner who shall certify the same. Proper documentation in this regard shall be maintained and handed over to the Owner.

(c) All the instruments shall be calibrated for the entire range of the instrument for which it is designed. Calibration shall include test for repeatability. After first commissioning, the instruments shall be tested for calibration again to check whether the instrument maintains its zero and maximum of the range.

(d) All instruments and control equipment shall be calibrated to read correctly to the satisfaction of equipment supplier / Owner.

(e) All switches shall be tested for the actuation of both normally open and normally closed contacts at the desired set points and also for the fixed / differential settings.

(f) All the float operated level switches shall be tested for the movement of the float and linkages to make to break the switch contacts by filling up with water before installation. For such tests, necessary testing set up required shall be arranged by the Contractor. All the conductivity type probes and switches shall be tested for performance before installation.

(g) Air leak tests shall be performed on all flue gas impulse / sample lines, air supply and pneumatic lines. Necessary equipment such as portable compressor, connecting pipes, materials, cables and test gauges shall be provided by the Contractor.

(h) Hydro test shall be performed for all other impulse lines / sampling lines. Necessary equipment such as hydro test pumps and temporary piping to the required point, fill pump etc., materials such as temporary gaskets, miscellaneous fasteners, etc. tools and tackles including test pressure gauges, etc. are to be provided by the Contractor.

(i) For all electrical actuators of the valves, functioning, setting and performance of limit switches / torque switches of various positions shall be checked before and after installation of the actuators. The position transmitters for inching applications shall also be calibrated.

(j) Pneumatic actuators shall be calibrated at site.

4.10.3 Commissioning requirements

(a) Prior to taking the instruments in service, all impulse lines, sampling lines and air supply lines shall be blown as required with the establishment of adequate line pressure and temperature conditions to keep the lines thoroughly clean.

(b) On-line i.e., without removing control valves from the pipe calibration of the positioners and stroking of control valves / control dampers shall be carried out as required during control system tuning.
(c) After delivery of the equipment, the Contractor shall locate all the equipment including electronic cards in its final position, check all the power wiring, grounding and interconnection cables, all in accordance with manufacturer's recommendations. The Contractor shall perform initialisation of system power, field loading of system configuration / software and data base, demonstration of system functionality to verify conformance with manufacturer's instructions and specifications, tuning of control loops, implementation of any configuration changes including hardware, software and additional tappings / instruments, cabinets as required and providing general trouble shooting and final solutions to application and / or instrument problems.

4.11 ELECTRICAL ERECTION, FIELD TESTING AND COMMISSIONING REQUIREMENTS

Equipment shall be checked for any physical damage and cleaned before taking up erection, the guidelines for installation, testing and commissioning of various electrical equipment as listed below shall be complied with.

4.11.1 The Installation of cable shall be as per code of practice detailed in Indian Electricity Rules.

4.11.2 The Contractor shall furnish all tools, welding equipment, rigging materials, testing equipment, test connections and kits, etc., required for complete installation, testing and commissioning of the electrical equipment included in the contract work.

4.11.3 All thefts of equipment / component parts, till the installation is handed over to the Owner, shall be made good by the Contractor.

4.11.4 In order to avoid hazards to personnel moving around the equipment such as switchgear, transformers, etc., which are kept charged after installation, before commissioning, such equipment shall be suitably cordoned off.

4.11.5 Irrespective of whether it is explicitly stipulated in the specification / drawings or not, any or all precautions, refinement, improvements, modifications that may be required to be carried out by the Contractor, in the installation shall be executed in a workman-like, technically sound and aesthetically pleasing manner.

4.11.6 Installation and commissioning shall be carried out after obtaining approval of concerned statutory authorities as required by Indian Electricity Rules. The Contractor shall be responsible for obtaining these approvals.

4.11.7 All electrical equipment shall be installed in neat, workman-like manner so that it is level, plumb, squat and properly aligned and oriented. Tolerances shall be as established in the manufacturer’s drawings.

(a) Switchgear, Control / Relay Panel

(i) Switchgears and control / relay panels / desks shall be installed in accordance with specified code of practice and manufacturer’s instructions.

(ii) In joining shipping sections of the switchgear / panels / motor control centres together, adjacent housing or panel sections shall be bolted together after completing the alignment.

(b) Motors

The installation, commissioning of the motors shall be as per the applicable code of practice and the manufacturer's instructions.
(c) Battery and chargers

Each cell of the battery bank shall be inspected for breakage and condition of cover seals as soon as received at site. Each cell shall be filled with electrolyte in accordance with the manufacturer’s instructions. Battery shall be set up on racks as soon as possible after receipt, utilising lifting devices supplied by the manufacturer. The cells shall not be lifted by the terminals.

4.11.8 Tests and commissioning

(a) All checks and tests as per the manufacturer’s documents / manuals, relevant code/ standard of installation and commissioning check lists for various electrical equipment e.g., transformers, breakers, isolators, CTs, PTs, motors, switchgear, relays, meters, etc., shall be carried out. All the pre-commissioning checks and tests considered necessary to ensure healthiness of equipment and to meet the performance expected, shall be conducted. All equipment to be used for testing and commissioning shall have approved calibration certificate from third reputed party valid at the time of testing.

(b) Minimum following commissioning checks shall be carried out on various equipment.

a) Motors

(i) Meggar testing of motor windings.

(ii) Resistance of motor windings (For HT Motors)

(iii) Phase sequence and rotation.

(iv) Operation of timers in star-delta starter.

(v) No load operation and observe vibration and temperature of motor body and bearings.

(vi) On load operation, starting and running currents. Observe motor body and bearing temperature and vibrations.

(vii) In case of CACW motors, inlet and outlet temperature to be noted.

(viii) Capacitance and tan delta in HT motors.

b) Circuit Breakers

(i) Checks alignment of breakers, trucks for free movement

(ii) Slow closing and opening operation.

(iii) Continuity check and IR value measurement.

(iv) Contact resistance measurement.

(v) Pole discrepancy tests

(vi) Closing and opening timings.
(vii) Closing and tripping velocities in 220kV breakers.

(vi) All functional checks

(vii) Checks on instrument transformers

c) Isolators

(i) Measure insulation resistance of each pole.

(ii) Manual and electrical operation and interlocks.

(iii) IR value measurement for control circuits.

(iv) Earth resistance between main contacts.

(v) Earth connection of structures and operating handle.

(vi) Clearance in open and closed conditions.

(viii) Simultaneous closing of all phases.

(ix) Milli volt drop test.

d) VTs and CTs

(i) Check earthing connections.

(ii) Insulation resistance test.

(iii) Polarity test.

(iv) Ratio test on all cores.

(v) Connections as per line diagram.

(vi) For CTs, the spare CT cores to be shorted and earthed.

e) Cables

(i) Meggar test between each core and armour / sheath.

(ii) Continuity check.

(iii) HV test on 6.6kV cables and above.

f) Battery

(i) Specific gravity test

(ii) Cell voltage check.

(iii) Capacity test as per IS.
g) Battery Charger

(i) Functional test of all devices.
(ii) Insulation test
(iii) Measurement of voltage regulation.
(iv) Measurement of no load current and voltage.
(v) Measurement of AC and DC voltage and current at various levels.
(vi) Voltage at 84th Cell (While boost charging).

h) CONTROL AND RELAY PANELS:

(i) Testing of all protective and auxiliary relays as per IS/ Manufacturer recommendation.
(ii) Checking of Internal Wiring, Interlocking and other tests as required.

(c) The Contractor shall perform operating tests on all switchgear and panels to verify operation of switchgear / panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all circuits, e.g., closing, tripping, control interlock, supervision and alarm circuits. All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.

5.0 PRELIMINARY OPERATION

Preliminary Operation shall mean all activities undertaken as part of Commissioning after Mechanical Completion upto commencement of Initial Operation and shall include mechanical and electrical checkpoints, calibration of instruments and protection devices, commissioning of sub / supporting systems and chemical cleaning covered under the Contract.

6.0 INITIAL OPERATION

6.1 Initial Operation shall include all operations undertaken as part of Commissioning after completion of Preliminary Operation upto commencement of Reliability Operation. It shall be the first integral operation of the complete Plant covered under Contract and shall include first light up / initial equipment rolling, equipment stretch-out, dry-out, no-load / partial load/ full loads runs for mechanical / electrical tryout and gathering of operational data; calibration, setting and commissioning of controls systems; and shutdown inspection and adjustment after running trials of the Plant under the Contract.

6.2 The initial operations shall include operation of unit as a whole under normal operating conditions for twenty four (24) consecutive hours at the 100% MCR load or twelve (12) consecutive hours for two (2) consecutive days at the 100% MCR load unless otherwise agreed to by the Owner / Engineer or restricted by system load conditions. The completion of initial operation will be certified in writing by the OWNER.

7.0 VOID
8.0 PERFORMANCE TESTS

8.1 The performance tests shall be conducted at site for unit and all major systems by the Contractor. The Contractor’s commissioning Engineers shall make the plant ready for such tests and assist the Owner in operation during the tests. The test will be commenced after the ‘Plant / Equipment’ has attained stable operation at the end of ‘Reliability operation’. The date of commencement of the performance tests shall be as soon as practicable on completion of the ‘reliability operations’ or as may be mutually agreed upon between the Contractor and Owner.

8.2 Independent Inspector

The Owner reserves his right to appoint an independent inspector at his own cost as his representative to discuss the test programme, to approve the instrumentation, to witness the tests and to analyse the test results.

8.3 The tests shall be binding on both the parties of the ‘Contract’ to determine compliance of the ‘Plant’ / ‘Equipment’ with the performance guarantees.

8.4 The performance tests shall be carried out to prove the guarantees and the unit characteristics as indicated below on the basis of principles enumerated herein. The purpose of the performance tests is not only to check whether the plant meets the guaranteed performances but also provide a full mass, heat and energy balance for the whole plant which will serve as reference to evaluate the plant performance in future over the plant life.

Overall heat balance data and calculation shall be provided by the Contractor in the “corrected as run” condition (i.e., “as run” condition corrected to the design condition by means of the correction curves).

8.5 The following unit characteristics tests shall also be conducted in the lignite firing mode:

Trip of each major equipment, including demonstration of auto operation of standby equipment, to be developed and mutually agreed upon in the testing procedure. Auto run back capability in case of equipment failure to be demonstrated.

8.6 The performance test procedure, including the definition of the calculation method to be used, the instrumentation to be installed, the instrument accuracy classes, the areas of responsibility and the items which specifically require preparation and agreement shall be submitted by the Contractor for review and approval by the Owner / Engineer during detail engineering phase. Schematics identifying the guarantee test instrumentation shall be submitted along with procedure. It shall be ensured that necessary test points and spool pieces are installed during the detail engineering phase and also identified in process and instrumentation drawings. For the purpose of heat rate guarantee, the SG and STG tests shall be carried out simultaneously. Though the test codes for SG and STG are different the correction curves shall be based on common measurement points and only those correction factors which affect overall heat rate alone would be applicable. The correction curves for the common guarantee test require to be submitted along with Bid. No additional corrections will be allowed. Test of cooling tower shall be carried out prior to SG and STG guarantee test and its performance proved. In case of under performance of cooling tower, necessary penalty as equivalent heat / nett output as applicable will be applied. Contractor shall furnish detail programme during detail engineering stage.

8.7 The performance test instruments shall be of precision type with instrument accuracy limits as required and defined in the applicable performance test codes such that measurement uncertainty does not exceed the values agreed to by the Contractor in the Schedule of Performance Guarantees. The performance tests shall preferably be carried out as per ASME performance test codes (detailed test codes) or test code agreed in schedule of performance guarantees.
8.8 All test instrumentation for the performance tests as required shall be supplied by the Contractor on loan basis. Data loggers on loan basis shall be used extensively for SG and STG tests. All costs associated with the supply, calibration, installation and return of the test instrumentation / data loggers / computers etc. are deemed to have been included in the contract price. The test shall be in accordance with those specified or as per agreed performance test codes. Batch calibration will not be accepted.

8.9 Any special equipment, tools and tackles required for successful completion of the performance tests shall be provided by the Contractor.

8.10 It is the Contractor’s responsibility to co-ordinate for suitably carrying out the performance tests. The duration of the test shall be in accordance with the agreed test codes at the loads after necessary stabilising period to obtain steady state conditions. All other tests to prove the guarantees as indicated in the Contractor’s offer shall also be conducted.

8.11 The plant parameters during the performance test shall be adjusted as far as practicable to the guaranteed performance test conditions. The tests shall be conducted to prove guaranteed parameters as defined in the contract.

8.12 The performance test results shall be reported as computed from the performance test observations with corrections for site conditions, variations in fuel, etc. and test conditions. Such correction curves shall be submitted along with the bid. No additional allowances for errors in measurement are permissible. The measurement uncertainty on the performance test guarantee values, as reported on the basis of above tests shall not exceed the uncertainty limits specified.

8.13 Reporting Of Test Results

Within two weeks after the conclusion of the performance test and unit characteristics tests, the Contractor shall submit a test report to the Owner with a copy submitted to the Engineer stating:

(a) In the case of a performance test, whether the unit passed or failed such test, accompanied by sufficient test data and calculations to demonstrate the level of performance attained with respect to each of the tested parameters.

(b) In case of a unit characteristics tests, the level of performance achieved with respect to the desired levels of performance.

The report(s) shall include as a minimum, the following:

(i) Description of the test procedures
(ii) Standards that were used
(iii) Instrumentation details and calibration
(iv) Full schematic diagrams with indication of instrument test location and identification tag of same.
(v) Test logs and summary of test readings used for performance calculations
(vi) Full set of correction curves
(vii) Computation of test results.
(viii) Computations to prove measurement uncertainty is within acceptable limits.
(ix) Conclusions of performance tests: test passed or not

8.14 Within fifteen (15) days of receipt such test report(s), the Owner shall submit a notice to the Contractor with a copy submitted to the Engineer, stating either:

(a) That Owner concurs with the information provided in the Contractor’s test report(s), or
(b) That Owner disputes some or all of the information provided in the Contractor’s test report(s), the areas being disputed, and the levels of performance being disputed.

8.15 If Owner disputes any or all of the results contained in the Contractor’s test report(s), representatives of the Contractor, Owner and the Engineer shall meet after the receipt of the Owner’s notice at a mutually acceptable location to review and discuss the dispute.

9.0 NOTICE OF TESTS

In relation to unit, the Contractor shall give to the Engineer and Owner 21 days’ notice of the date after which he will be ready to make the tests on completion (the “Tests”) and the Contractor shall commence the tests promptly thereafter. Any data obtained in respect of Gross Heat Rate, Power Output and auxiliary power consumption prior to the commencement of the Tests in relation to the Performance Guarantees shall not be used to assess whether the Performance Guarantees have been attained.

10.0 DELAYED TESTS

10.1 If the tests could be carried out but are being unduly delayed by the Contractor the OWNER/Engineer may by notice require the Contractor to make the tests within 14 days after the receipt of such notice. The Contractor shall make the tests on such days within that period as the Contractor may fix and of which he shall give notice to the OWNER/Engineer.

10.2 If the Contractor fails to make the tests within 21 days of such notice the Engineer may himself proceed with the tests. All tests so made by the Engineer shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from the contract price or charged to the Contractor. The tests shall then be deemed to have been made by the Contractor.

10.3 Retesting

If any unit fails to pass the test (which in the case of performance tests means achieving the acceptable limits), the Engineer or the other major Contractor may require such tests to be repeated on the same terms and conditions save that only reasonable notice of the date and time of such tests shall be required to be given by the Contractor to the Engineer.

10.4 Disagreement as a Result of Tests

If the OWNER/Engineer and the Contractor disagree on the interpretation of the test results, each shall give a statement of his views to other within 14 days after such disagreement arises. The statement shall be accompanied by all relevant evidence.
### LIMESTONE HANDLING SYSTEM – DATA SHEET - A

#### 1.0 GENERAL

1.1 Designation  
Limestone Milling and Conveying

1.2 Capacity of Mill  
TPH  
Up to 80 TPH

1.3 No. of mills  
nos.  
Three (3) (2 W + 1 S)

1.4 Location  
As per Plot Plan

1.5 Type  
Ball mill

1.6 Type of operation  
Continuous

1.7 Type of Grinding  
Dry

1.8 Direction of Mill Rotation  
CCW - View from DE

#### 2.0 DESIGN DATA

2.1 Input lump size  
mm  
90% passing 25 mm. Max lump size 40 mm

2.2 Density  
kg/m$^3$  
1200

2.3 Maximum moisture content  
%  
20

2.4 Output fineness  
100% < 1 mm  
80% <= 200 microns  
50% <= 0.16 mm  
90% => 0.04 mm

2.5 Design hard grove index  
60

2.6 Turn down ratio  
4:1

2.7 Noise level  
DBA  
85 dBA at distance of 1 m from the equipment surface. (Mill shell and trunnion will be covered with Acoustic Chamber)

2.8 Product Moisture  
< 1% Moisture

#### 3.0 FEATURES OF CONSTRUCTION

3.1 Adjustment of classifier vanes  
Required

3.2 Lube oil system  
Pressurized
3.3 Sealing air system Required

4.0 MATERIALS OF CONSTRUCTION

4.1 Body shell and heads Fabricated from heavy rolled steel plate. Minimum thickness of the shell shall be 32 mm with 50 mm thick flanges and shall be provided with suitable doors for the maintenance. Mill heads shall be of high quality cast steel grade 27-54 of IS 1030.

4.2 Liners for cylindrical shell and feed and discharge ends 12 to 14 % Manganese steel of IS-276.

4.3 Liners for classifier Manganese steel.

4.4 Grinding balls Cast steel IS 6079 - 80 with 350 BHN

4.5 Classifier Abrasion resistant material

4.6 Girth gear Cast steel of IS 2644 and pinion will be of EN-24

4.7 Coupling Fluid Coupling

4.8 Bearing housing By bidder

4.9 Base plate MS fabricated with epoxy paint.

4.10 Foundation bolts By bidder

4.11 Pinion for Girth Gear By bidder

5.0 ACCESSORIES Bidder to indicate

5.1 Turning gear Required

5.2 Ball feeding system Required

5.3 Mill brake Required

5.4 Coupling guards Required

5.5 Oil cooler Required

5.6 Lime stone fineness sampling points Required

5.7 Local instruments Required
5.8 Foundation bolts and nuts Required

5.9 Recommended maintenance tools Required (As per list)

5.10 Recommended spares Required (As per list)

5.11 Mill motor and mill components handling equipment Required

5.12 Mill Acoustic enclosure Required

6.0 Ball Mill

6.1 Quantity One for each mill

6.1.1 Mill Feeder Type Weigh Feeder

6.1.2 Mill Discharge Arrangement Swept through outlet duct

6.2 Construction features

6.2.1 No. of Manholes two

6.2.2 Out of Roundness +/- 10 mm

6.3 Head and Trunnion

6.3.1 Type of Head Fixing with the Shell Bolted

6.3.2 Attachment of Trunnion with Head Integral

6.4 Shell and head liners

6.4.1 Type Replaceable

6.4.2 Mounting / Fixed Arrg. Forged Steel Bolts with Self Locking arrangement

6.5 Trunnion Bearings

6.5.1 Type of Starting the System For Floating the Mill HP Oil

6.6 Girth Gear

6.6.1 Construction Split
6.6.2 Gear Guard Description Segment
6.6.3 Mounting Details Bolted

6.7 Pinion
6.7.1 Construction Integral with Shaft
6.7.2 Mounting Details On Spherical Roller Bearings

6.8 Input Coupling
6.8.1 Type Fluid Coupling

6.9 Low Speed Shaft Coupling
6.9.1 Type Gear Coupling with Torque tube
6.9.2 Coupling Guard Provided

6.10 Charge
6.10.1 Type Balls

7.0 Bag filter

7.1 General
7.1.1 Type Reverse Pulse Jet
7.1.2 Dust concentration on exit gas mg/Nm³ Less than 50
7.1.3 M.O.C / Thickness of Casing mm IS 2062 Gr .A/5

7.2 Bag cleaning
7.2.1 Type of bag cleaning Compressed instrument air purging
7.2.2 Type of controlling Solid state sequential

7.3 Filtering Media
7.3.1 Material Polyester Needle Felt
7.3.2 M.O.C of Cage SS-304
7.3.3 M.O.C/Thickness of Tube Sheet mm IS 2062 Gr.A/5
7.3.4 Bag fixing arrangement Snap band for main bag filter and Collar for insertable bag filter
7.4 Rotary Air lock Motorized, Bidder to furnish all the details

7.5 Slide gate Manual

8.0 Hot Gas Generator

8.1 General

8.1.1 Number One for each mill.

8.1.2 Type HFO fired Hot air generator

8.1.3 Duty Continuous

8.1.4 Turndown ratio 4:1

8.2 Fuel Handling & Firing System for each Mill

8.2.1 Main fuel Heavy Fuel Oil (HFO)

8.2.2 Atomizing Medium Steam

8.2.3 Material of Pipes SA 106 Gr.B/C

8.2.4 Quantity of Pumps Nos. 2 x 100%

8.2.4 Quantity of heaters Nos. 2 x 100%

8.3 Initial Ignition

8.3.1 Pilot Fuel LPG

8.4 Burner

8.4.1 Burner type Hot Compressed air atomized type

8.5 Day Oil Tank

8.5.1 Material of construction Mild steel

8.5.2 Capacity 6m³

8.6 Combustion Air Fan Bidder to furnish all the details

8.7 Dilution Air Fan Bidder to furnish all the details

8.8 Accessories

8.8.1 Valve stand Yes, Bidder to Indicate
8.8.2 PF stand Yes, Bidder to Indicate

9.0 I. D. Fan

9.1 Casing Split type

9.2 Inlet box (split type) IS:2062

9.3 MOC of Inlet cone IS:2062

9.4 MOC of Casing IS:2062

9.5 MOC of Impeller SAILMA 350H1

9.6 MOC of Shaft 080 M40 (EN8)

9.7 MOC of Shaft Seal IS:2062

9.8 Method of Flow Control Multi Louvre Damper

9.9 Type of operation for flow control Motorized

10.0 Cyclone Bidder to furnish all the details

10.1 MOC IS 2062Gr.B

11.0 Grit separator Bidder to furnish all the details

11.1 MOC IS 2062Gr.B

12.0 WEIGH FEEDER

12.1 Method of feed Gravity feed from Hoppers

12.2 Material

12.2.1 Feed size mm 100% < 40 mm

12.2.2 Angle of repose deg 35

13.0 Screw Conveyor

13.1 Screw

13.1.1 Type of Screw Sectional Screw

13.1.2 Hard facing 65 mm depth with hardness of 450 -500 BHN and 3 mm thickness

13.2 Shaft
13.2.1 Type of shaft  
Seamless pipe

14.0 Dome valve for Transporting Vessel

14.1 Location  
Vessel inlet & outlet

14.2 Valve Type  
Dome type

14.3 Make  
Moeller-Germany

15.0 Cast Basalt

15.1 Shell thickness  
5mm as per IS - 2062

15.2 Cast basalt thickness  
20mm +/- 3

15.3 Radius of curvature  
5D

16.0 Rotary Air Lock Feeder

16.1 Capacity  
TPH  By bidder

16.2 Size & quantity  
By bidder

17.0 Dome Valves

17.1 MOC

17.1.1 Dome  
Cast Iron

18.0 Diverter Valves  
Bidder to furnish all the details

19.0 Slide Gate

19.1 MOC

19.1.1 Flap Liner  
SAIL HARD

20.0 Double Flap Valve

20.1 MOC

20.1.1 Hopper Liner  
SS-304

20.1.2 Flap  
SAIL HARD

20.1.3 Flap Liner  
SS-304

21.0 Flexible joint  
Bidder to furnish all the details
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<tr>
<th>Section</th>
<th>Description</th>
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<td>Non Metallic Expansion joint</td>
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<td>23.1</td>
<td>Operation</td>
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<td>Lubrication System</td>
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<td>Pipe Material</td>
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<td>Type of Oil Cooler</td>
<td>Plate Type Heat Exchanger</td>
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<td>Medium of cooling</td>
<td>ACW (DM Water)</td>
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<td>25.0</td>
<td>Gear box for main drive</td>
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<td>26.0</td>
<td>Grease spray system for Girth Gear</td>
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<td>Pipe Material</td>
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<td>26.2</td>
<td>Type of Pump</td>
<td>As per Bidder’s standard practice.</td>
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<td>Product Bin</td>
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<td>28.0</td>
<td>Conveying Vessel</td>
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<td>Limestone Conveying Pipe</td>
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<td>29.1</td>
<td>Pipe Material</td>
<td>MS ERW BLACK-IS3589</td>
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<td>29.2</td>
<td>Pipe Schedule</td>
<td>SCH-40 Minimum</td>
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<td>29.3</td>
<td>Type of Joint</td>
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VOLUME- III

DRAWINGS & SCHEDULES
2 X 250 MW THERMAL POWER STATION

Bharat Heavy Electricals Limited
We the undersigned hereby certify that the above-mentioned information's are the ONLY deviations.
The bidder shall state below the weights and dimensions of various packages for shipment covering the complete scope.

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### PARICULARS OF BIDDER / AUTHORISED REPRESENTATIVE

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We the undersigned hereby undertake to meet the performance guarantees as listed in the table above on the conditions as elsewhere specified. Any variation of the specified conditions during official test will be taken in to account by the customer.

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