

GMR KAMALANGA ENERGY LIMITED



**1X350 MW EXTENSION OF
3x350 MW KAMALANGA THERMAL POWER PROJECT
AT
DHENKANAL DISTRICT, ODISHA, INDIA**

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VOL IIB

**TECHNICAL SPECIFICATIONS
FOR
ASH HANDLING SYSTEM (EPC BASIS)**

**[FINAL]
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CONSULTANT



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SECTION : I

**TECHNICAL SPECIFICATIONS
FOR
ASH HANDLING SYSTEM**



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VOLUME: II-B**SECTION - I****TECHNICAL SPECIFICATIONS FOR ASH HANDLING SYSTEM****1.00.00 INTENT OF SPECIFICATION**

1.01.00 This specification is intended to cover the system description, design criteria, construction details, performance requirements and scope of Engineering Procurement, Construction, testing and commissioning for complete Ash Handling System along with all accessories as specified herein and as required for safe and trouble-free operation of the Coal based sub- critical unit of 1x350 MW, extension of 3x350 MW Kamalanga Thermal Power Project at Dhenkanal, Kamalanga, Odisha.

2.00.00 SYSTEM DESCRIPTION

The ash handling system under this specification to be provided by the Bidder is to be completed and comprehensive in all respect for collection & transportation of Bottom Ash and Fly Ash generated from Coal fired Steam Generators.

A brief description of the various sub-systems comprising the entire Ash Handling System has been enumerated below.

2.01.00 Ash formed due to combustion of Coal in the steam generator shall be collected at the respective locations

- a) As Bottom Ash
- b) Economizer, APH, Duct Hopper, Selective Catalytic Reduction hopper
- c) As Fly Ash from (ESP) and Fabric Filter.

2.01.01 Bottom ash, Economizer, APH, Duct Hopper ash collection & disposal shall be continuous with Magaldi / Clyde Bergemann OR equivalent dry BA conveying system located below bottom ash hopper under the furnace of steam generator. Bottom ash drops in a steel transition hopper coated with a refractory material. The transition hopper absorbs the shock of bottom ash's direct drop to the extractor conveyor. Bottom ash is conveyed to a primary crusher while being cooled by air on the extractor conveyor. Bottom ash finally disposed to steel BA silo

2.02.00 DESCRIPTION OF THE BOTTOM ASH HANDLING SCHEME

Brief description of the Bottom Ash Handling Scheme has been presented below:

2.02.01 Dry Bottom Ash Removal System

Dry bottom ash removal system from bottom of boiler to silo shall be constituted with following major parts:-

- 1) Dry Bottom ash Hopper

- 2) Isolation gate
- 3) First stage bottom ash conveyor (along with coarse ash as per requirement)
- 4) Crushing arrangement
- 5) Second stage bottom ash conveyor(if required)
- 6) Storage ash silo

In this context, it is to be noted that Economiser ash, SCR hopper ash, APH ash and Duct ash shall be conveyed directly to bottom ash silo through four separate pneumatic conveying lines. These four lines shall be connected at suitable points (opposite to impingement plate) at filter separator cum buffer hopper fitted above BA silo.. High and low level probe shall be provided to actuate the opening and closing of bottom gate of filter separator cum buffer hopper. Ash from combination filter separator cum buffer hopper shall be disposed to an isolation chamber fitted below it.

Effective ash storing capacity of filter separator cum buffer hopper shall be of 30 minutes of different coarse ash conveyed to it at rated capacity ie 16 Ton.

Economiser hopper Cleaning rate(TPH)	32 TPH
APH hopper Cleaning rate(TPH)	32 TPH
Duct hopper Cleaning rate(TPH)	32 TPH
SCR hopper Cleaning rate(TPH)	32 TPH
Cleaning style of coarse ash hoppers	One type of hoppers will be cleaned at a time. All type of hoppers shall not be cleaned simultaneously
Maximum cleaning rate of all type of hoppers	32 TPH
Maximum storage time	30 minutes
Effective storage capacity	16 ton

Beneath bag filter com buffer hopper, an isolation chamber(having effective ash storing capacity 16 ton) shall be provided(as stated above) with one pneumatically operated and mechanically operated isolation gates. Isolation chamber is required to be provided to avoid entry of pressurised air directly to BA silo while combination filter separator cum buffer hopper bottom gate will be operating Isolation chamber shall be provided with necessary venting and equalising arrangement through adequate sized pipes and pneumatically operated valves.

From isolation chamber, coarser ash shall be disposed to BA silo. Disposal line shall be provided with one pneumatically operated and mechanically operated isolation gates. In other words,

Combination filter cum buffer hopper, isolation chamber etc shall be equipped with all necessary arrangement & instrumentation to inhibit entry of pressurised air to boiler via enclosed BA silo and BA carrying enclosed conveyor

1) **Dry Bottom Ash Hopper**

The furnace bottom of boiler unit will be provided with a bottom ash hopper, which will be installed and supported from ground floor with structural support. The hopper shall be lined with suitable refractory and insulation inside to with-stand the radiation from the combustion chamber of the boiler. The hopper shall be sized with a storage capacity of 8 Hours in full load with worst coal basis).

A heat resistant mechanical seal shall be installed between the boiler outlet and the bottom ash hopper. The design of the mechanical seal is adapted to the movement between the boiler and the hopper caused by temperature changes from cold to hot during operation. In this context, it is to note that temperature of bottom ash being deposited in bottom ash hopper may be high as 1100 deg C

The mechanical seal is multilayered made up of multi material, resistant to high temperature (1050 deg C) and resistant to the negative pressure inside the Boiler. To avoid the damages due to high temperature by the radiant heat from the combustion chamber, a special protecting skirt with lining shall be provided at the inner side of the mechanical seal. The mechanical seal will assure tightness and the required flexibility to allow the boiler movement. In the need of change it can be easily replaced by a new one disassembling the respective flanges and bolts.

2) **Isolation Gate**

The bottom ash hopper shall have multiple hydraulically operated refractory lined gates at bottom to isolate the hopper for carrying out maintenance in the metallic conveyor. Isolation gates may be provided into two banks in such a way that one V section of bottom ash hopper can be isolated with one bank of isolation gates.

3) **First Stage Bottom Ash Conveyor**

Dry ash conveyor (termed as first stage bottom ash conveyor) is located beneath the outlet of the aforesaid bottom ash hopper. It is designed to cool the bottom ash with air only, without any use of water. First stage bottom ash conveyor is made up of steel and is completely enclosed in an air tight housing ensuring a tight seal. This belt is envisaged to operate like a rubber conveyor belt between the drive pulley and tail pulley. The belt is supported

by carrying idlers across its entire width in order to withstand heavy mechanical impact and prevent sagging beyond a limit.

A pneumatic take up device is envisaged in the tail pulley to ensure constant tension on the first stage bottom ash conveyor.

Maintenance / inspection doors are provided for inspection or maintenance of the conveyor.

The drive station, an electric motor with gear-box, is automatically regulated by a frequency controlled drive combination, so that the velocity of the first stage bottom ash conveyor is always as low as possible. This guarantees little wear. In case high amount of bottom ash is to be transported, the drive needs to change the velocity to higher speed. Later when the ash quantity becomes normal, the drive needs to reduce the velocity to predetermined one.

The idler bearings are provided with at both ends of the conveyor enclosure. This will facilitate the quick and easy change of supporting bearings from outside the conveyor enclosure. Greasing/lubrication arrangement of roller bearings from out side of the steel casing shall be provided.

Cooling air inlets are located preferably on the casing of the first stage bottom ash conveyor. Controlled quantity of air inflow is allowed through this inlets which cools bottom ash in counter flow direction.

The intent is to achieve cooling without use of water. Air flow within the conveyor to furnace to achieve the cooling shall be as per Supplier's design and shall be within acceptable limit of BTG & ESP package supplier. Requirement of one or two nos. conveyors to achieve the output temperature & meeting the plant layout, shall be as per Supplier's design. Proven technologies of Dry Bottom ash handling system is acceptable.

The first stage BA conveyor is slow moving to allow cooling of ash during the passage to discharge end. The negative draft in furnace will cause atmospheric air to enter into the conveyor enclosure through the controlled openings, cool the ash, the resultant hot air entering the furnace. The un-burnt carbon in clinkers also completes the combustion with oxygen being supplied with the incoming air. Thus heat will be recovered improving the efficiency of the boiler.

Bottom ash shall be cleared from the hopper continuously. However the first stage bottom ash conveyor and associated equipment capacity, motor power etc shall be such that in emergency condition eight (8) hours BA generation can be cleared in four (4) hours with speed adjustment.

The configuration of hopper shall be designed such that the load on the belt due to accumulated material is minimized.

Conveyor shall be suitable to take shock load, and shall operate successfully during soot blowing of furnace. At least 20% margin shall be provided in design capacity over maximum rated capacity of conveyor.

The conveyor shall have suitable hydraulic / pneumatic auto adjusting take up arrangement. The conveyor drive shall have VFD to enable step-less speed variation.

Alternative proven dry bottom ash handling system employing the above operating principle with cooling air traveling along the surface of the hot bottom ash on steel plate conveyor in counter flow direction can also be considered.

4) **Crushing Arrangement**

Crushing arrangement of Dry bottom ash system shall be as follows:-

1. Pre-crusher : Pre- crusher (2X100% for each unit) may be provided at the discharge point of first stage bottom ash conveyor. Pre-crusher unit, as mentioned, shall be equipped with adequate system to prevent pollution during crushing.
2. Primary crusher : 2X100% Primary crusher unit shall be provided to further crush the pre-crushed bottom clinker(bottom ash) to down size to (-)50 MM. Primary crusher unit, as mentioned, shall be equipped with adequate system to prevent pollution during crushing. The primary crushing unit shall discharge the crushed bottom ash into the bottom ash silo or to second stage bottom ash and coarse ash conveyor as per lay out & as well as system requirement.

5) **Second Stage Bottom Ash conveying conveyor(if required)**

Second stage bottom ash conveyor is to be provided, if required as per plot plan AND/OR if required to cool down bottom ash to desired temperature. Bottom ash shall be cleared beneath the boiler continuously. However the second stage bottom ash conveyor and associated equipment capacity, motor power etc shall be such that in emergency condition eight (8) hours BA can be cleared in four (4) hours with speed adjustment. In other words, capacity of Second stage bottom ash conveyor, if applicable, shall be 60 TPH dry ash (approx.) maximum and 30 TPH continuous.

The Second stage bottom ash conveyor will discharge cooled bottom ash into the bottom ash silo.

The temperature of bottom ash at entry to bottom ash silo shall not be more than 120 deg C at worst ambient temperature considering boiler design conditions and 170 deg C considering extreme boiler operating conditions. Cooling shall have to be achieved by use of atmospheric air & water spraying will not be accepted.

Second stage bottom ash conveyor shall be suitable to take shock load, and shall operate successfully during soot blowing of furnace. At least 20% margin shall be provided in design capacity over maximum rated capacity of conveyor.

The conveyor shall have suitable hydraulic / pneumatic auto adjusting take up arrangement. The conveyor drive shall have VFD to enable step-less speed variation.

Worst coal under BMCR condition(TPH)	279
Ash percentage in worst coal	45%
Bottom ash generated in TPH considering worst coal BMCR condition(@20% of total Ash	25.11TPH
Total Bottom ash generated in eight(08) hour shift(TPH)	200.88 TPH
Ash disposed for shoot blowing @20%	40.176
Total BA in eight hour shift	241.056 T
Maximum cleaning time	4 hours
Maximum Cleaning rate(TPH) with speed adjustment	60 TPH(rounded off figure)
Normal minimum Cleaning rate(TPH) without speed adjustment	30TPH(rounded off figure)

6) **Coarse Ash Removal System (By Pneumatic conveying)
(From Economiser Hoppers to bottom ash silo)**

- a) It is envisaged that there shall be around four (4) hoppers under the Economiser section of boiler. Each individual Economiser hopper shall be provided with manual isolation valve and metallic expansion joint. . Economizer ash shall be conveyed to BA silo by pneumatic conveying system using master slave arrangement. One ash conveying pipe will emerge , from all economizer hoppers, carrying coarse ash to combination filter cum buffer hopper fitted above BA silo.
- b) The Economiser Coarse Ash system shall run for 30 minutes in a eight hour shift including down time and change over time considering worst coal BMCR condition. In other words, economizer hopper ash generated in eight hour shift considering worst coal BMCR condition, shall be cleared within 30 minute s including change over and down time.

In this connection, it is to note that temperature of economizer hopper ash, may be high and lies in the range 340 Deg C to 130 Deg C .So equipment's and down stream arrangements shall be provided to suit the same.

Worst coal under BMCR condition(TPH)	279
Ash percentage in worst coal	45%
Economiser hopper ash generated in TPH considering worst coal BMCR condition(@3% of total Ash	4TPH(rounded off figure)
Total economizer hopper ash generated in eight(08) hour shift(Ton)	32 Ton

Maximum cleaning time	60 minutes
Cleaning rate(TPH)	32 TPH

7) **APH Hopper Ash , Duct Hopper ash & SCR hopper ash Removal System**
(From corresponding Hoppers to bottom ash silo via pneumatic conveying system)

Arrangement shall be similar to coarse ash removal system.

The APH Hopper Ash , Duct Hopper ash & SCR hopper ash removal of the boiler unit shall be done once in a eight hour shift by pneumatic conveying system.

One pneumatic ash conveying pipe shall emerge from four APH hoppers, carrying ash from these hoppers, to combination filter separator cum buffer hopper arrangement fitted above BA silo. Ash from APH hoppers shall be cleared through master slave arrangement. Cleaning time of ash generated in these hoppers in a eight hour shift considering worst coal BMCR condition has been tabulated below.

In this connection, it is to note that temperature of Air Pre-Heater (APH) hopper ash may be high and lies in the range 200 Deg C to 120 Deg C .So equipment's and down stream arrangements shall be provided to suit the same.

Worst coal under BMCR condition(TPH)	279
Ash percentage in worst coal	45%
Air preheater Hopper ash generated in TPH considering worst coal BMCR condition(@2% of total Ash	3TPH(rounded off figure)
Total economizer hopper ash generated in eight(08) hour shift(Ton)	24 Ton
Maximum cleaning time	45 minutes
Cleaning rate(TPH)	32 TPH

One pneumatic ash conveying pipe shall emerge from four duct hoppers, carrying ash from these hoppers, to combination filter separator cum buffer hopper arrangement fitted above BA silo. Ash from duct hoppers shall be cleared through master slave arrangement. Cleaning time of ash generated in these hoppers in a eight hour shift considering worst coal BMCR condition has been tabulated below.

In this connection, it is to note that temperature of duct hopper hopper ash may be high and lies in the range 180 Deg C to 110 Deg C .So equipment's and down stream arrangements shall be provided to suit the same.

Worst coal under BMCR condition(TPH)	279
Ash percentage in worst coal	45%
Duct Hopper ash generated in TPH	3TPH(rounded off figure)

considering worst coal BMCR condition(@2% of total Ash	
Total Duct hopper ash generated in eight(08) hour shift(Ton)	24 Ton
Maximum cleaning time	45 minutes
Cleaning rate(TPH)	32 TPH

One pneumatic ash conveying pipe shall emerge from four Selective Catalytic Reduction (SCR) hoppers, carrying ash from these hoppers, to combination filter separator cum buffer hopper arrangement fitted above BA silo. Ash from Selective Catalytic Reduction (SCR) hoppers shall be cleared through master slave arrangement. Cleaning time of ash generated in these hopes in a eight hour shift considering worst coal BMCR condition has been tabulated below.

In this connection, it is to note that temperature of Selective Catalytic Reduction (SCR) hopper ash may be high and lies in the range 450 Deg C to 230 Deg C .So equipment's and down stream arrangements shall be provided to suit the same.

Worst coal under BMCR condition(TPH)	279
Ash percentage in worst coal	45%
Selective Catalytic Reduction Hopper ash generated in TPH considering worst coal BMCR condition(@2% of total Ash	3TPH(rounded off figure)
Total Selective Catalytic Reduction hopper ash generated in eight(08) hour shift(Ton)	24 Ton
Maximum cleaning time	45 minutes
Cleaning rate(TPH)	32 TPH

8) Storage Silo System

a) Bottom ash Silo size selection

Coal required per boiler When operating at full load with Worst coal firing .	279TPH
Maximum Ash in Coal	45%
Maximum ash generated	125.55 TPH
Bottom ash @20%, Economiser ash@3% , APH ash @ 2% , Duct Hopper ash @2% , SCR hopper ash 2% Total 29% of total ash generated	36.41 TPH
Retention time in Silo considered	18Hrs
Total bottom ash, Eco ash, APH ash, Duct Hopper ash & SCR Hopper ash generated for1X 350MW unit in 18 Hr duration	655.38 Ton=655 Ton(rounded off figure)
Bottom ash density	0.65 T/ CuM
Capacity of bottom ash silo selected	1008. CuM (rounded off figure)

b) One number bottom ash silo (having tentative dia 10Meter)is envisaged for 350 MW unit. Bottom ash silo capacity is estimated to

be around 1008 Cu.M (effective dry ash holding capacity ie leaving one meter blank space over maximum material holding height) and the said silo can store bottom ash and Eco. Ash, APH ash, SCR hopper ash & Duct Hopper ash generated in 18 hours from proposed boiler unit.

BA silo will be provided with pressure relief access door, continuous level sensing device, high level sensing device and unloading equipments, etc.

This BA silo shall be adequately sloped conical bottom design with conical portion having 6 mm thk. Stainless steel lining.

- c) Bottom ash silo shall be provided with four number opening to dispose ash accumulated in it. One opening will be dedicated for disposing conditioning/ moistened ash on open tanker @ 120TPH. One opening will be provided for disposing dry ash on closed tanker through telescopic spout arrangement @ 120TPH. Two openings will be dedicated for future ash unloading purpose and this shall be kept blanked.
- d) Bottom ash silo shall be provided with following equipments :
 - i) One (1) no Rotary Conditioners cum un loaders shall have unloading capacity 120 TPH (dry ash basis).
 - ii) One (1) no Telescopic chute shall have unloading capacity 120 TPH (dry ash basis) with scavenger fan, bag filter and rotary feeder. Telescopic spout arrangement is needed for dry unloading of ash in closed tanker.
 - iii) Two (2) no number of blanked connection for future use
 - iv) Access door to provide entrance to silo interior for maintenance or inspection.
 - v) Continuous level detection devices to indicate ash level
 - vi) Relief valve to handle any unusual pressure surges in the silo
 - vii) High ash level sensing device.

Silo shall be designed in such a way that free movement of ash unloading trucks can be ensured.

Minimum clearance between silo unloading / operating floor and paved ground below shall be 5.5 M minimum. Silo area shall be paved and a peripheral drain shall be provided. The discharge of this peripheral drain/plant clarifier system to suit the site condition. Silo area shall have proper fencing.

2.03.00 Consumers Requiring Ash Water in Bottom ash system

- a) Spray water for rotary unloaders below the bottom ash silo.
- b) Emergency spraying system for bottom ash cooling at strategic locations under exigency condition.

Spray water required for ash conditioning system will be tapped from raw water/cooling tower blow down water header at one suitable point at unit#3. . Water requirement for conditioning system may also be fulfilled by any other suitable water source near bottom ash silo area. Water pipes, supports , booster pumps, fittings along with eccentric reducers, water tapping arrangements, valves etc beyond this single tapping point to ash conditioning system is under scope of dry bottom ash handling package.

Emergency Spray water required for bottom ash cooling system will be tapped from raw water/cooling tower blow down water header at one suitable point at unit#3.. Water requirement for emergency spraying system may also be fulfilled by any other suitable water source near bottom ash hopper area. Water pipes, supports, booster pumps, fittings along with eccentric reducers, water tapping arrangements, valves etc beyond this single tapping point is under scope of dry bottom ash handling package.

2.04.00 Consumers Requiring Clean & Clarified Water

- a) Seal water is required for drain pumps.

The above requirement will be met from one suitable point at unit#3. Water pipes, supports, booster pumps, fittings along with eccentric reducers, water tapping arrangements, valves etc beyond this single tapping point is under ash handling package bidder's scope of supply.

2.05.00 Instrument Air Supply System

Instrument air required for ash handling system will be tapped from system instrument air header at one suitable point (@ 5 Kg/Sq Cm) at Unit#3 and will be fed at various consumption points dedicated for ash handling system. Galvanized screwed end pipes (properly sloped), galvanized fittings along with eccentric reducers, water trap arrangements, valves, air receivers etc beyond this single point to various consumption points of ash handling system is under scope of bottom ash handling package.

2.06.00 Drain Pumping System

2 x100% vertical, Centrifugal, single stage, semi-open or (open non-clogging) type impeller type drain pumps shall be provided, near dry bottom ash silo area. These pumps shall dispose dirt and sludge accumulated in corresponding pit to plant clarifier or at any other point as desired by client during detail engineering stage. Pumps, motors, valves, instruments, pipes upto disposal point is in scope of supply of Bidder.

2.07.00 Fly ash pressure conveying system description

a)

ESP – Ash evacuation & transportation in dry form will be done in one stage. In proposed system 40 nos ESP hopper shall be connected with three independent streams for delivering ESP ash either to existing fly ash silo-4 AND/ OR to existing fly ash silo#3. For this arrangement, one ash conveying line shall emerge carrying fly ash from 4 hoppers of first field and four hoppers of second field. Since there are 8 number of hoppers in each field, hence total two ash conveying line shall emerge from First & second field of ESP hoppers. One ash conveying line shall emerge carrying fly ash from Eight number hoppers of third field and 16 number fabric filter hoppers .

In this connection, it is to note that change over arrangement with adequate number pneumatically operated KGV shall be provided in pneumatic ash conveying lines(carrying FA from hoppers to silos) so that so that any one of the above mentioned existing silos can be chosen by any pneumatic line, to suit site requirement.

The ash conveying capacity of above mentioned three lines shall be 82TPH, 82TPH and 7 TPH (approx) respectively considering 8 hour ash being conveyed in 5 hrs including change over & down time(considering data from old units.)

b)

However alternatively, for system balancing, following arrangement may be envisaged.(Please refer flow diagram 24A11-BOP-DWG-M-002, sheet 1 of 3)

One ash conveying line shall emerge carrying fly ash from two hoppers from each field (i.e. two from ESP first field, two from ESP send field, two from ESP third Field, two hoppers from FF 1st row, two hoppers from FF 2nd row). Thus there will be total four number ash carrying pipes and conveying capacity of each pipe shall be around 45 TPH(rounded off) considering 8 hour ash being conveyed in 5 hrs including change over & down time(considering data from old units.)

In this connection, it is to note that change over arrangement with adequate number pneumatically operated KGV shall be provided in pneumatic ash conveying lines(carrying FA from hoppers to silos) so that so that any one of the above mentioned existing silos can be chosen by any pneumatic line, to suit site requirement.

c)

For any reason, if Mechanical handling of BA system cater only BA ash & Eco ash, then APH & duct hoppers ash may be clubbed with fly ash conveying system (of ESP+FF hopper ash). In that case master slave arrangement shall be followed and coarser ash shall be conveyed with the help of fine ash. In that case, vendor may propose alternative arrangement for review during pre order finalization stage.

2.08.00 Fly ash from silo shall be further disposed in dry & moist form through closed & open trucks.

2.09.00 Spraying , cooling, sealing, jetting water system

a)

Bidder to design, supply, erect and commission of a complete water circuit required for ash disposal from unit-4 ash silo.(conditioned ash as well ash unloading to truck/bulker and lean ash mixture to ash dyke)

It is comprising of water pumping from existing guard pond, including pump with motor(1W+1SB), piping. Water storage tank for 5 hrs requirement (or 500m3 effective holding capacity ,which ever is higher) ,pumps with motor (1W+1S) for supplying required volume of water for lean mixture and ash conditioning. Including electrical and C&I system

b)

Clarified/seal water requirement for Fly Ash silo area drain pump sealing and drain sump jetting shall be met by tapping from nearest water header provided by client @ of 10 meter from boundary limit. All valves, booster pump(if required), Instruments beyond the boundary limit shall be in Bidder's scope of supply. Seal water requirement can be met taking tapping from nearby service water header.

c)

Cooling water required for newly supplied compressors etc shall be tapped from water headers provided by client at unit#3. All valves, booster pump(if required), pipe supports, Instruments beyond the boundary limit shall be in Bidder's scope of supply. It is envisaged that equipment cooling water (ECW) requirement for conveying air compressors, instrument air compressors, dryers, etc., shall be met from passivated DM water network

NOTE-

Ash handling bidder shall inform the client about water quality and quantity, as required for the above mentioned water arrangement, during pre order finalization stage.

2.10.00 The Instrument air system shall be provided @5Kg/sq cm by client at Unit#3. Galvanized screwed end pipes (properly sloped), galvanized fittings along with eccentric reducers, water trap arrangements, valves, air lubricators, regulating system, pipes, instruments, alarms , air receivers etc beyond this single point to various consumption points of ash handling system is under scope of fly ash handling package.

2.11.00 Air cooled fluidizing air blowers(1W+1SB) along with heaters(1W+1SB) for ESP hoppers shall be located near ESP 1st field. Fluidising air 5 CFM per square feet of fluidizing pad area is to be considered.

Bidder shall supply 3 nos air cooled fluidizing blower with heater for silo 3 and 4 (2W+1S) along with changeover valves(Plug valve preferable between blower & heater and ball valve preferable from heater outlet onwards). Change over lines shall be arranged in such a way that any blower can access any heater, as and when required. Fluidizing air 5 CFM per square feet of Fluidizing pad area is to be considered.

2.12.00 Owing to conveying of ash to the existing silos, bag filter capacity(existing) may demand alteration. In that case, additional bag filter and exhaust air fan at the outlet of bag filter shall be provided in each silo considering whole ash is being deposited into single silo. Out let air PPM from silo bag filter exhaust shall be within 30mg / normal cubic Meter.

Each silo shall be provided with two pressure relief valve, high level probe and continuous level sensing equipment. If at present, any of the mentioned equipment found missing, same shall be provided by Bidder and these shall be in their scope of supply.

NOTE-

Each exiting silo(silo#3& #4) is equipped with one telescopic spout ash disposal arrangement(for disposing ash into close tanker) and two number moist ash unloading arrangement(at open truck) and one opening is kept blank for future use. If any of the above mentioned items are found missing or inadequate, same shall be refurbished/newly provided by Bidder. Bidder is requested to confirm the same during order finalization stage.

3.00.00 SCOPE OF SUPPLY & WORK

The scope of work of the Bidder covered under the specification is described herein under. The items, which are not specifically mentioned or missed out but needed to make the system complete and reliable for safe operation and guaranteed performance shall also be treated as included and the same shall be furnished unless otherwise categorically excluded.

The Bidder shall take a note that design, engineering of the entire Ash Handling System envisaged in the specification is responsibility of the Bidder himself. Such design engineering essentially includes system design and sizing of all equipment / components. In case of confusion and contradiction between subsections, if any there, the Bidder is advised to seek clarifications from Owner during the pre-offer stage itself. Quantities indicated in the below mentioned clauses are broadly indicative and for the purpose of tendering only.

3.01.00 Bottom Ash Handling System

Bottom Ash, Economizer Ash, APH Ash, Duct Hopper Ash Collection and Disposal System

3.01.01 Dry Bottom Ash Removal System

- 1) One (1) mechanical expansion joints (mechanical seal) (guaranteed for minimum three years of continuous operation) to adsorb the boiler vertical and lateral expansions and thermal shock for one unit.
- 2) One no (1) refractory & insulation lined structural steel bottom ash hoppers equipped with adequate number bottom hydraulically/pneumatically operated doors along with provision of manual isolation (& lump braking devices as required) in BA hopper-, capable of storing Eight hours of bottom ash (considering 100% PLF and worst coal) inside the hopper, independently from the extractor. Bottom ash hopper will be equipped with

poke holes, access doors, observation and inspection glass windows, supporting steel structure, platforms, stairs and all accessories as specified and as required.

- 3) One (1) dry bottom ash steel belt conveyor (First stage bottom ash conveyor) for proposed boiler unit with variable frequency drive, automatic / hydraulic chain tensioning arrangement, 2X100% gear motors(if required) in first stage bottom ash conveyor with all accessories as specified and as required. Maximum conveying capacity of first stage BA conveyor shall not be less than 60TPH.

In first stage bottom ash conveyor following features shall be ensured:-

Positive drive arrangement with chain & sprocket: Chain & idler away from hot ash, impact of falling clinker should be on structural beam mechanism & not on idlers.

The conveyor shall have infra red camera to monitor the ash temperature across the total conveyor length and control the discharge ash temperature.

- 4) Two (1W+1S/B) pre-crusher devices, hydraulically activated and able to break lumps of very large dimension.
- 5) Two (1W+1S/B) primary crushers(dry type) complete with all total for proposed unit, with drive, located after the first stage bottom ash conveyor discharge that reduces the size of the larger ash agglomerates and lumps, one (1) in operation and one (1) in stand-by with wheels for an easy replacing.
- 6) If applicable, suitable cooler arrangement below primary crusher to bring down the temperature of dry bottom ash depending upon dries BA temperature.

3.01.02 second stage ash carrying conveyor **for Bottom Ash** ,

If applicable, one (1) second stage bottom ash , carrying conveyor total for proposed unit. This conveyor will carry cooled bottom ash , and will dispose the same to bottom ash silo. This conveyor will be totally enclosed with adjustable air entry inlet. Second stage conveyor shall be provided with drive , 2x100% gear motor, if required, , conveyor speed control and associated automatic/ hydraulic chain tensioning arrangement. Capacity of second stage conveyor shall not be less than 60TPH.

3.01.03 Bottom **ash Silo**

One (1) no bottom ash silo with all accessories for proposed unit

Bottom ash silo, properly lined with 6 mm thk SS in the conical portion, having effective holding capacity 875 ton(ie 1345CuM, refer note below), dry ash basis shall be provided with minimum four number opening to dispose ash accumulated in it. One opening will be dedicated for disposing (@ 120TPH, dry ash basis) conditioning/ moistened ash on open tanker. One opening will be provided for disposing dry ash (@ 120TPH, dry ash basis) on closed tanker through telescopic spout arrangement. Two openings will be dedicated for future ash unloading purpose and these shall be kept blanked. Silo shall be provided with adequately sized vibrators (if required), continuous level detecting devices, High level probe, pressure relief valves, poke hole , maintenance hole, staircase, access platform etc as required as per good

engineering practice. Silo unloading floor shall be at least 5.5M above finished floor level.

Note- Bottom ash silo effective capacity(ie excluding 1 Meter free space above top level of deposited ash and dead volumes) is estimated to be around 1345 Cu.M Ash temperature inside BA silo is envisaged as 100 Deg Centigrade.

Two rotary feeder having capacity 120 TPH each (dry ash basis). Out of these rotary feeder, one will feed ash to dust conditioner arrangement and the other one will provide ash in controlled form to telescopic spout arrangement.

One telescopic spout with manual KGV, cylinder operated KGV level switch, trapped air relief cum dust catching arrangement as required. Unloading capacity of telescopic spout arrangement shall be 120TPH (minimum).

One filter separator cum buffer hopper(having effective ash storage capacity 16 ton) and one isolation chamber((having effective ash storage capacity 16 ton) shall be provided above BA silo.

Coarser ash conveying lines(total four lines or adequate number of lines as per final design)) carrying coarser ash(ie Eco ash, APH ash, Duct Hopper ash & SCR hopper ash) shall dispose it at suitable position of combination filter cum buffer hopper. Filter bags in combination filter shall be adequately designed to cater face velocity 1M/minute and can withstand temperature of hot air(as emerged to atmosphere).Exhaust air fan fitted above combination filter separator cum buffer hopper shall also be in bidder' s scope of supply

Disposal lines of ash from Combination filter separator to isolation chamber and from isolation chamber to BA silo shall be designed in such a way to prohibit entry of pressurized air into boiler through enclosed BA carrying conveyor via BA silo. Valves shall be provided pneumatic type and additional manual isolation valve shall be provided at each ash exit points of combination filter separator cum buffer hopper and isolation chamber.

Necessary venting, equalizing/depressurizing valves, pipes, liners, instruments etc as required and as mentioned in specification or as indicated in flow diagram shall be in scope of supply of Bidder.

3.02.00 Pneumatic conveying of coarse ash to BA silo

3.02.01 Pneumatic conveying of economizer hopper ash

It is envisaged that there shall be around four (4) hoppers under the Economiser section of boiler. Each individual Economiser hopper shall be provided with manual isolation valve and metallic expansion joint. . Economizer ash shall be conveyed to BA silo by pneumatic conveying system using master slave arrangement. One ash conveying pipe will emerge , from all economizer hoppers, carrying coarse ash to combination filter cum buffer hopper fitted above BA silo. Conveying rate shall be 32 TPH (minimum).

All expansion joints, isolation valve(pneumatic for remote operation and hand chain operated manual valve for maintenance isolation), level probes(high & low) in each hopper, downstream conveying lines, bends with basalt lining, instruments and all

other necessary arrangement for smooth operation of the system shall be bidder's scope of supply.

In this connection, it is to note that temperature of economizer hopper ash, may be high and lies in the range 340 Deg C to 130 Deg C .So equipment's and down stream arrangements shall be provided to suit the same.

Arrangement shall be provided in such a way that any individual hopper & corresponding ash conveying vessel can be isolated manually keeping ash conveying running with other hoppers & conveying vessels.

3.02.02 Pneumatic conveying of APH hopper ash

Scope of supply of Bidder for APH hopper ash cleaning arrangement shall be similar as economizer ash system

One pneumatic ash conveying pipe shall emerge from four APH hoppers, carrying ash from these hoppers, to combination filter separator cum buffer hopper arrangement fitted above BA silo. Ash from APH hoppers shall be cleared through master slave arrangement. Cleaning rate(minimum) shall be 32 TPH

All expansion joints, isolation valve(pneumatic for remote operation and hand chain operated manual valve for maintenance isolation), level probes(high & low) in each hopper, downstream conveying lines, bends with basalt lining, instruments and all other necessary arrangement for smooth operation of the system shall be bidder's scope of supply.

In this connection, it is to note that temperature of Air Pre-Heater (APH) hopper ash may be high and lies in the range 200 Deg C to 120 Deg C .So equipment's and downstream arrangements shall be provided to suit the same.

Arrangement shall be provided in such a way that any individual hopper & corresponding ash conveying vessel can be isolated manually keeping ash conveying running with other hoppers & conveying vessels.

3.02.03 Pneumatic conveying of duct hopper ash

Scope of supply of Bidder for duct hopper ash cleaning arrangement shall be similar as economizer ash system.

One pneumatic ash conveying pipe shall emerge from four duct hoppers, carrying ash from these hoppers, to combination filter separator cum buffer hopper arrangement fitted above BA silo. Ash from duct hoppers shall be cleared through master slave arrangement. Cleaning rate shall be 32 TPH(minimum)

All expansion joints, isolation valve(pneumatic for remote operation and hand chain operated manual valve for maintenance isolation), level probes(high & low) in each hopper, down stream conveying lines, bends with basalt lining, instruments and all other necessary arrangement for smooth operation of the system shall be bidder's scope of supply.

In this connection, it is to note that temperature of duct hopper ash may be high and lies in the range 180 Deg C to 110 Deg C. So equipment's and downstream arrangements shall be provided to suit the same.

Arrangement shall be provided in such a way that any individual hopper & corresponding ash conveying vessel can be isolated manually keeping ash conveying running with other hoppers & conveying vessels.

3.02.04 Pneumatic conveying of SCR hopper ash

Scope of supply of Bidder for SCR hopper ash cleaning arrangement shall be similar as economizer ash system.

One pneumatic ash-conveying pipe shall emerge from four Selective Catalytic Reduction (SCR) hoppers, carrying ash from these hoppers, to combination filter separator cum buffer hopper arrangement fitted above BA silo. Ash from Selective Catalytic Reduction (SCR) hoppers shall be cleared through master slave arrangement. Cleaning rate shall be 32 TPH (minimum).

All expansion joints, isolation valve (pneumatic for remote operation and hand chain operated manual valve for maintenance isolation), level probes (high & low) in each hopper, downstream conveying lines, bends with basalt lining, instruments and all other necessary arrangement for smooth operation of the system shall be bidder's scope of supply.

In this connection, it is to note that temperature of Selective Catalytic Reduction (SCR) hopper ash may be high and lies in the range 450 Deg C to 230 Deg C. So equipment's and downstream arrangements shall be provided to suit the same.

Arrangement shall be provided in such a way that any individual hopper & corresponding ash conveying vessel can be isolated manually keeping ash conveying running with other hoppers & conveying vessels.

3.03.00 Drain Pumping System

Two numbers (one working and one stand by) vertical drain pumps for bottom ash silo area with discharge piping to deliver the drain water to plant clarifier. These pumps may also be utilized for handling BA hopper area drain depending upon final layout.

3.04.00 Instrument Air system

Instrument air required for dry bottom ash handling system will be tapped from plant instrument air header at Unit#3 and will be fed at various consumption points dedicated for ash handling system. Galvanised screwed end pipes (properly sloped), galvanised fittings along with eccentric reducers, water trap arrangements, valves Air receivers, air lubricator, regulator, alarm etc beyond this single point to various consumption points of ash handling system is under scope of bottom ash handling package.

A total requirement of 1 NCuM/Min/Boiler unit @ 5Kg/SqCm(g) is envisaged. Bidder to confirm the same during pre-bid stage

At least one (1) Air Receivers complete with all fittings, vent connection, trap drain stations, relief valves, instrumentation, valve fittings, supports etc. For distribution of air in the bottom ash silo area one additional receiver may become necessary because of distance to absorb pressure excursion. This will also be in scope of bidder. Moisture separator shall be provided.

3.05.00 Water System for Ash Handling System

Spray water required for ash conditioning system will be tapped from nearby raw water header at Unit#3 at one suitable point. Water requirement for conditioning system may also be fulfilled by any other nearby suitable water source of Unit#3. Water pipes, fittings along with eccentric reducers, water tapping arrangements, valves etc beyond this single point to ash conditioning system is under scope of dry bottom ash handling package.

Emergency Spray water required for bottom ash cooling system will be tapped from seal water pump discharge header or plant clarified water discharge header at one suitable point at Unit#3. Water pipes, fittings along with eccentric reducers, water tapping arrangements, valves booster pump, pipe supports etc beyond this single point to ash conditioning system is under scope of dry bottom ash handling package.

3.06.00 Seal/Clarified Water System

All of the requirements will be met from clarified/ seal water supply header (for Ash Handling system) provided by client.

Seal/clarified water required for bottom ash handling system will be tapped from Station Plant Water System Package at unit#3. Pipes, fittings, valves, booster pump, pipe supports etc beyond this single point to various consumption points of ash handling system is under scope of ash handling package.

3.07.00 Hoisting Equipment, Air Conditioning and Ventilation System

- a) Monorail hoist shall be provided for equipment / moving parts weighing more than 1 ton.

Selection of crane capacity shall be guided by 110% of heaviest load to be handled.

All control rooms shall be air conditioned with window/ package air conditioners. Electrical room for MCC shall be air conditioned with dust & moisture proof arrangement. Adequate ventilation fans are to be provided in the equipment building/ rooms associated with dry bottom ash handling system package.

3.08.00 Following are to be provided/ensured by dry bottom ash package supplier :-

- a. One number dedicated PLC, one number dedicated MCC and one number dedicated Inverter are to be provided for Dry bottom ash system. These shall be put in a air conditioned room near bottom ash silo. The make of PLC, Inverter, MCC should be as per approved vendor list.

- b. Superior hardened MOC of primary crusher teeth shall be provided
- c. Moisture separator com air lubricator shall be provided at IA tapping point to strictly prohibit moisture ingress. If required additional measures shall be provided by dry bottom ash system supplier to restrict moisture ingress..

3.09.00 The detailed EPC scope includes engineering, procurement and construction of the following sub- systems, associated with this plant, although have not been specified in detail within this volume shall be deemed to be included within the package and has also been covered in detail in corresponding sections. The scope of such work under this design basis report includes, but not limited to the following:

- a) All Civil Work of and pertaining to the bottom ash Handling Plant.

List of Work - The scope of work shall also include complete civil design, engineering, furnishing BBU for payment, furnishing of civil construction drawings, supervision, supply , & execution of civil works associated with dry bottom ash handling and evacuation system. The scope shall also include supply of base plates, sole plates, foundation bolts, anchor bolts, sleeves, steel inserts, embedment and bar bending schedules for the associated civil works for complete bottom ash handling system & related items as included in this package. In this context it is to be noted that civil structures like dry bottom ash handling control room, bottom ash handling system associated electrical rooms, all staircases, bottom ash silo, conveyor of first stage and subsequent stages of conveying etc are included in scope of supply of this package.

- b) All Structural Work (Steel) etc. complete with galleries, platforms etc.
- c) All Architectural - complete design, engineering, furnishing BOQ, furnishing of construction drawings, supply of material, supervision & execution for all architectural Work are in scope of supply of bottom ash handling package.
- d) All Electrical items within the Terminal Points of this Package.
- e) All Instrument - As required and as per standard/good engineering practice including cables, junction boxes; instrument hardwares and softwares, etc.
- f) Ventilation – Dry Bottom Ash handling system control room and wherever PLC System & related equipments are placed shall be air-conditioned; All other Rooms Conditioning System and Buildings shall be properly ventilated by judicious selection system of equipment.
- g) Fire Protection - As per recommendations of Tariff Advisory Committee (TAC) and applicable fire safety code as well as per good engineering practice for all Buildings installing equipment and having operator habitation.
- h) Electric Overhead- As required in the bottom Ash Handling Plant.
- i) Erection, Testing, Pre-commissioning - As required as per good engineering practice. Adherence to Safety codes/norms etc. are deemed to be included in scope.
- j) The interfacing points with boiler design to ensure that boiler performance is

not unduly affected due to installation of the bottom ash handling system.

3.10.00

Scope of Services shall include the following(if not mentioned else where or in the EPC part of specification

- i) Complete cleaning, protection and painting.
- ii) Packing, forwarding and transportation to site including transit insurance.
- iii) Shop testing of all equipment.
- iv) Unloading, storage and handling at site, leveling, grouting, erection of plant, touch up painting at site, final checkup, testing and commissioning of all equipment and accessories of the complete plant
- v) Any additional equipment and materials or work, which is not specifically mentioned, but required to make the installation complete in every respect shall be under the scope of work.
- vii) To arrange for necessary handling equipments, if required, for the erection of equipment under the scope.
- viii) Supervision of equipment Civil/Foundation work.
- ix) Lubricants (oil/ grease) till commissioning. (i.e., till the commissioning of the Unit is over.)
- x) Mandatory spares.- Mandatory spare list shall be shared by bidder to owner for review before finalisation
- xi) Recommended spares- Recommended spare with price shall be shared by bidder to owner for review
- xii) Special tools and tackles

3.11.00

Fly Ash Handling System

Pressure Conveying System (From ESP Ash Hoppers to Fly ash silos)

The fly ash removal system from ESP hoppers will depend upon the alternatives chosen, as elaborated in the corresponding clause (refer clause 2.07.00-Fly ash pressure conveying system description).. Total dry ash pressure conveying pipes from ESP & FF hopper hoppers outlet onwards up to Fly ash silos complete with pipe fittings, couplings, clamps, structural supports, access platform, etc. shall be in bidder's scope of supply. All FA conveying pipes , emerging from ESP & FF hoppers, shall merge in both the existing fly ash silos so that whole/part ash generated by boiler can be disposed to any one of them, as and when necessary.

Each ESP hopper & FF hopper shall be provided with two level probes(one for high level and one for low level. All these level probes and corresponding connection, system etc, as required, shall be in bidder's scope of supply.

3.11.01

Required number of Manual chain wheel operated isolation valves, one (1) no. at the outlet of each ESP & FF hopper shall be under the scope of supply of Bidder.

3.11.02 Required number of conveying vessel fitted below each ESP & FF hopper along with ash intake, ash outlet valve, fluidizing arrangement, venting & equalizing arrangement, clean pneumatic air line orifice, isolation & throttling valves, ball valves in fluidising air line, other valves, limit switches, flanges & counter Flange, bends etc and all associated instruments, local and remote panels shall be bidder's scope of supply.

Arrangement shall be provided in such a way that any individual hopper & corresponding ash conveying vessel can be isolated manually keeping ash conveying running with other hoppers & conveying vessels.

3.11.03 Fluidizing system complete with air cooled air blowers(1W+1SB), suction filters, relief valves, discharge pressure indicators, drive motor, air heaters(1W+1SB), temperature indicators, fluidizing pads, insulated piping, valves and other accessories as necessary and as per respective specification for continuous supply of heated air to all ESP & FF hoppers simultaneously through pads for easy flow of ash. Fluidising air 5 CFM per square feet of fluidising pad area is to be considered. In this context please note that rat hole formation probability of FF hoppers shall be eliminated if fluidizing air is being provided. Air cooled fluidizing air blowers(1W+1SB) along with heaters(1W+1SB) shall preferably be located near ESP 1st field. And same shall be in scope of supply of FA handling Bidder.

Instrument air required for ash handling system will be tapped from system instrument air header at one suitable point (@ 5 Kg/Sq Cm) from Unit#3 , (Bidder shall ascertain the details) and will be fed at various consumption points dedicated for ash handling system. Galvanized screwed end pipes (properly sloped), galvanized fittings along with eccentric reducers, water trap arrangements, valves, air receivers , air lubricators, pipe supports etc beyond this single point to various consumption points of ash handling system is under scope of ash handling package.

Air Cooled fluidizing air blowers(2W+1SB) along with heaters(2W+1SB) for Existing silos(silo#3& #4) shall be in scope of supply of Bidder.. Change over valves(Plug valve preferable between blower & heater and ball valve preferable from heater outlet onwards) shall be in Bidder's scope of supply. Change over lines shall be arranged in such a way that any blower can access any heater, as and when required. Fluidising air 5 CFM per square feet of fluidising pad area is to be considered. All valves, pipes, instruments, and associated arrangement for smooth fluidisation of all silo pads and required individual pad isolation valve(ball type), pipe supports, pipe insulation(to maintain hot temperature of air) and all associated arrangements for smooth system operation and signal clubbing with existing control rooms shall be in bidder's scope of supply. Bidder to design, supply, erect and commission of a complete water circuit required for ash disposal from unit-4 ash silo.(conditioned ash as well ash unloading to truck/bulker and lean ash mixture to ash dyke).It is comprising of water pumping from existing guard pond, including pump with motor(1W+1SB), piping. Water storage tank for 5 hrs requirement (or 500m³ effective holding capacity ,which ever is higher) ,pumps with motor (1W+1S) for supplying required volume of water for lean mixture and ash conditioning including electrical and C&I system.

3.11.04 Owing to conveying of ash to the existing silos, bag filter capacity (existing) may demand alteration. In that case, additional bag filter and exhaust air fan at the outlet of bag filter shall be provided in each silo considering whole ash is being deposited into single silo. Out let air PPM from silo bag filter exhaust shall be within 30mg /

normal cubic Meter.. Face velocity across bags of filter cloths shall not be more than 1.5Meter/minute under 50% chock condition

Each silo shall be provided with two pressure relief valve, high level probe and continuous level sensing equipment. If at present, any of the mentioned equipment found missing, same shall be provided by Bidder and these shall be in their scope of supply.

Each exiting silo(silo#3& #4) is equipped with one telescopic spout ash disposal arrangement(for disposing ash into close tanker) and two number moist ash unloading arrangement(at open truck) and one opening is kept blank for future use. If any of the above mentioned items are found missing or inadequate or malfunctioning, same shall be refurbished/newly provided by Bidder.

- 3.11.05 All interconnecting pipes, valves, fittings, couplings and instruments etc. (not mentioned above) along with its support shall be provided as per the system requirement.

Fly ash line termination through existing & newly build pipe rack up to Silo-4 & Silo-3 inlet will be under the scope of vendor. 700mm Wide walkway with 1.6Meter height railing for existing and newly build (by AHP Bidder) pipe rack shall be in bidder's scope. It is envisaged that Bidder understands the gamut of pipe rack which are to be newly built by them with proper design , maintaining erection procedure and adequate material supply.

- 3.11.06 Four number (2W+2SB) conveying compressors shall be provided for pneumatic conveying of ash. Compressors shall be oil free screw compressor type. Four number air dryers(2W+2SB) shall be provided to dry the conveying air. Air dryer capacity shall be such that one dryer can cater full flow of one compressor. Arrangement with isolation valves(ball valves) shall be provided in such a way that any compressor can access any dryer, as and when required. All instruments, valves, pipes etc, as required for the system, shall be in Bidder's scope of supply.

In this context, it is to note that bidder may provide two identical compressors (1W+1SB) for fly ash handling and two identical compressors (1W+1SB) for coarse ash pneumatic handling.

- 3.11.07 Three (03) nos Air receiver tanks already exist, but not in service. Bidder to check condition of same, do necessary recitations and TPI certification before taking into service. Bidder shall do all piping as per requirement. Valves, auto drain traps, pressure relief valves, pressure gauge, pressure switch, isolation valves etc as required for air receivers along with pipes , pipe supprts, pipe racks etc shall be in bidder' s scope of supply.

Clarified water requirement for Fly Ash silo area drain pump sealing and Fly Ash silo area drain sump jetting shall be met by tapping from nearest service water header Or from nearby suitable source. All piping, valves, instruments, beyond tapping point shall be in bidder's scope of supply

- 3.11.08 **Compressed Air System (Instrument Air quality)**

Instrument air required for fly ash handling system will be tapped from plant instrument air header at one suitable point at unit #3. and will be fed at various

consumption points dedicated for ash handling system. Galvanised screwed end pipes (properly sloped), galvasised fittings along with eccentric reducers, water trap arrangements, valves Air receivers, air lubricator, regulator, alarm, pipe support etc beyond this single tapping point to various consumption points of ash handling system is under scope of bottom ash handling package.

3.11.09 One (1) nos. air receiver of 5m³ capacity complete with pressure indicator, pressure transmitter, safety valve, moisture auto drain trap, etc. shall be provided in the silo area, if required.

3.11.10 Bidder shall consider additional equipment/system as mentioned below:-

- 1- 01 no mixing tank agitator.
- 2- 01 no telescopic chute with venting system for silo-4
- 3- Silo-3 & 4 Bag filter and vent fan design to review in capacity to enhance (if required)..(as mentioned in clause 3.11.04)
- 4- Supply of dry ash unloader and ash conditioner for silo-4
- 5- 02 nos of electric operated hoist for fly ash silo-4 (01 nos 5T capacity at silo top and 01 no 3T capacity near ash conditioner floor)
- 6- DFDS(dry fog dust suppression) system for silo-1 and silo-4 at silo unloading points(ie at points of ash unloading to open truck and at close truck). Pressured air shall be tapped from IA or service air header near Unit#3. All piping, supports, local air receiver, air regulator, ball valves, instrumentations & auto control shall be in scope of bidder. Water for DFDS may be tapped from water pipes meant for moist unloading system or from water header at Unit#3 (which ever is suitable). All pipes, supports, valves, booster pump (if required), instrumentation, auto control and feed back to control room etc shall be in scope of bidder. DFDS system shall be actuated, as and when required. Method of actuation shall be clearly spelt by the bidder in their technical offer so that same can be finalised before opening price part of Bid.
- 7- 02 nos drain pump with 15kw motor, pipes, valves all electrical and instrumentation accessories at drain sump of existing ash water tank . Discharge pipe to be connected to (High efficiency settling tank) HEST tank. Position of HEST tank has been indicated in plot plan. Please refer annexure of specification for plot plan
- 8- 01 no charge pump with motor and electrical & instrumentation.
- 9- 04 nos pump with motor for corner pit , all electrical and instrumentation accessories (55KW)(near fly ash silo area)
- 10- 01 no recovery pump with 75kw motor (300m³/hr) with all electrical and instrumentation(at ash pond)
- 11- A Separate PLC room (control room) may be designed & considered for Silo area. (considering all four units) including all civil, mechanical, electrical, HVAC work

12- 4 nos 110 KW electrical feeder for LP pump.

3.12.00 Clarified water system for compressor cooling

3.12.01 Clarified water (similar to existing one) has been envisaged for cooling of AHS equipment & auxiliaries (compressors, etc.). Piping system (beyond tapping point at unit#3) with all accessories, valves, supports specialties and local instruments such as sight flow indicators, temperature gauges, pressure gauges; temperature transmitters etc. shall be provided by the Bidder

3.13.00 Service air system

3.13.01 Service air shall be provided at the following locations.

- 2 nos. in each ESP area
- 1 no. in AHS compressor house
- 2 nos. in Main Fly Ash Silos
- 1 no. in Silo utility building

Above mentioned requirements are the minimum. Additional service air points shall be provided by the Bidder depending on system requirement. The service air will be provided from Plant service air network.

3.14.00 Civil, Structural and Architectural Scope

The scope shall consist of the following structures/buildings as mentioned below :

- Bottom ash Hopper
- BA Overflow sump

For details, refer specification Vol – IIG/1 & Vol – IIG/2 for Civil, Structural & Architectural works.

3.15.00 Electrical Scope

The Successful Bidder shall provide the package Motor Control Center (MCC) or Power Distribution Boards (PDB) for small loads. Estimated power requirement and load lists should be submitted during bidding stage. All MCC shall be with double incomer and PDB shall be with single incomer. Engineering, supply, erection and commissioning of the complete power distribution system from the respective MCC/PDB incoming side (including main cable routing from the feeder provided by the client and branch cable tray routing shall be done by bidder) to the individual loads of the package shall be in the scope of the package contractor.

The successful Bidder shall comply with the applicable sections of project technical specification [VOL-IIF1, IIF2, IID] for all equipment provided and their protection, except for any special requirements of the application.

All scope related clauses mentioned in this package-specific document shall supersede other documents in case of any contradiction.

- a. All power and control cable tray required shall be in bidder scope and in wet ash area cable tray shall be FRP type
- b. All electrical Motor shall be energy efficient type (IE4)

- c. Bidder to consider VFD as required for all motors.
- d. Bidder to consider the erection of connecting cable tray for power and control cable from existing nearby cable tray from main plant to proposed AHP package switchgear room and also for each motor & LCP where ever required. Only two number of 415V feeder shall be provided from main plant PCC for AHP package
- e. All HT, LT and control cable from main plant required for AHP and compressor package shall be consider by bidder scope and only required number of HT 6.6kV feeders for compressor shall be provided by Owner .
- f. For compressor required HT,LT& Control cable tray shall be constructed by bidder from nearest main cable tray at ESP
- g. All other required LT cable and tray for compressor shall be in AHP package.
- h. All required switchgear (PCC, MCC) with 2X100% capacity and spare feeders complying with the technical specification for each rating shall be considered for whole AHP package.
- i. Illumination for AHP package shall be consider as per IS standard.
- j. All equipment Earthing and lightning system shall be in scope of bidder and main package earthing shall be connected to existing nearby earthing grid at two points.
- k. Bidder shall consider numerical relay for all feeders and digital meter for energy measurement system and complying communication protocol shall be available for remote monitoring and remote operation of all feeders.
- l. Bidder to consider the illumination system along the ash conveying pipe rack system.
- m. Welding socket and maintenance box shall be provided in every 50mtr length along the pipe rack and at bottom ash system as required.
- n. Bidder shall be responsible for all required regulatory approval like Approval from CEA/State Electrical Inspectorate etc.
- o. Bidder shall Comply with IS /IEC standards for all electrical equipment in AHP package.
- p. Bidder to design , supply and erection , testing commissioning of new MCC panel having 2X100% capacity for silo area additional loads as required for unit#4 fly ash handling process like 4 no 110kw LP pump,4 no corner pit motor having 55 kw motors,new PLC room auxiliary supply, 4 no vent fan load , 2 no drain pump of 15 kw each, and others auxiliary loads as required for the process which are mentioned in this document.
- q. Bidder to design, supply and erection of cable tray and power and control cable for mentioned new required loads as well as incoming power supply cable from existing SILO PCC as per detail design.
- r. Supply and laying of all power and control cable (both HT and LT) meant for incoming power supply to PCC, MCC, PDB, LDB, and MDB and also all out going cable from the boards to the equipment within the package is in bidder scope.
- s. Bidder to ensure the testing and commissioning of all mentioned required electrical equipment
- t. Bidder to consider modification work if required like cable tray and its support structure work which required for fly ash electrical system.
- u. Bidder to consider remote operation (PLC) of additional loads as mentioned in this scope

3.16.00 Control and Instrumentation Scope

The Instrumentation and Control System shall be complete in all respects and adequate for safe, reliable and efficient operation of the plant under normal and worst service and environmental conditions. Instruments, systems and equipment and their installation shall conform to high standards of engineering design and workmanship in all respects.

C&I system for the AHP of unit#4 shall be based on Programmable Logic Controller (PLC). Make of PLC shall preferably be Allen Bradley similar to the existing units.

PLC system shall be complete with redundant CPU, redundant power supply and redundant communication modules. I/O modules shall be provided as per process requirement. Remote I/O cabinets shall be provided at strategic locations as guided by the process requirement.

Two (2) nos. 24 inch Operator workstation (OWS), one (1) no. 24 inch Operator cum Engineering workstation (OEWS), one (1) no. 70 inch LVS, one (1) no. redundant server, A3/A4 size Laser printer, Ethernet switches, OFC cables with accessories etc, as required for unit#4 AHP control system shall be provided by the bidder.

The control system and its peripherals shall be powered from redundant UPS which is in bidder's scope.

AHP PLC of unit # 4 shall be integrated with the existing network as some signals will be used both for U#3 & 4 . Also Integration of the PLC with existing SILO control system (PLC) will be in bidder scope .

Common AHP control room of units#1,2 and 3 shall be used for unit #4 also. A new control room shall be constructed as finalized during detailed engineering to accommodate the control system of existing units with all necessary works as required and shall be integrated with owner's existing control system . Existing SILO control room will be shifted to new SILO Control room. All necessary action for shifting to new CCR will be in bidder scope .Equipment supplied for SILO area for Unit#4 shall be integrated with owner's existing control system .

All pumps & other equipments, as under scope of bidder shall be integrated with existing system and same shall be in scope of bidder. Integration work, as needed, during/after construction of new control room, shall be in bidder's scope of supply.

Entire cabling (supply, laying and termination) including that from instruments to local panels / instrument racks/ JBs/ RIOS etc and from there up to PLC shall be in bidder's scope.

Cable from PLC to MCC/ SWGR and electrical actuator with integral starters, LPBS for drives, etc shall be in bidder's scope. Cables shall be provided as per Specification volume –IIE.

All control cable & cable tray for AHP design & supply required for integration will be in bidder scope .

All field instruments required for AHP system shall be in bidder scope with standard compliance and shall be calibrated at site (Calibration testing of instruments by NABL approved LAB at site before erection is to be carried out by bidder). Detailed instrument specifications/datasheets shall be provided. All instruments and system shall be provided as per approved vendor list. All tools required for testing shall be in bidder scope. All Hopper HH & H level switch all fields including Economiser & APH shall be in bidder scope.

Non-contact type continuous level measurement shall be provided for of ASH hoppers. Working principle of the instrument shall be NOGS (Naturally Occurring Gamma Ray Sensor). 4-20 mA DC signal from the instrument shall be connected to the PLC .

All HT drives shall be provided with bearing vibration monitoring (both X & Y direction) and bearing & winding temperature monitoring.

Separate Electronic earthing system for AHP shall be provided. For electronic system cabinets, the electronic system ground bus shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open.

For detail specification of PLC and instrumentation system please refer specification Volume IIE.

3.17.00 Miscellaneous

- 3.17.01 Mandatory spare as described in Lead Specification-Volume-II-A of this specification
- 3.17.02 Tools and tackle as specified in Lead Specification-Volume-II-A of this specification.
- 3.17.03 All lubricants, greases, for initial fill, testing, flushing etc. till the provisional taken over of the entire AHS.
- 3.17.04 Drawings, documents, manuals etc. as described in various sections of this specification.
- 3.17.05 All tests at works and site as described elsewhere in this specification under relevant clauses.
- 3.17.06 Packing, forwarding and transportation to site including transit insurance.
- 3.17.07 Unloading, storage and handling at site, leveling, grouting, erection of plant, touch up painting at site, final checkup, testing and commissioning of all equipment and accessories of the complete plant
- 3.17.08 Any additional equipment and materials or work, which are not specifically mentioned, but required to make the installation complete in every respect, shall be under the scope of the specification.
- 3.17.09 The Bidder shall arrange his own insurance for storage associated with scope of contract defined above.

- 3.17.10 The Bidder shall arrange for necessary handling equipment, if required, for the erection of equipment under his scope.
- 3.17.11 Monorail with hoist along with structural support shall be provided for all Drain sump pump.
- 3.17.12 For garlanding of disposal pipe the Bidder shall visit site to ascertain actual scope of work.

4.00.00 DESIGN BASIS

4.01.00 Ash Collection Data

Following ash collection details shall be considered for the AHS design which is based on typical data of a steam generator of 350 MW capacity.

Description	Percentage (%) of Ash Generation	Quantity of ash generation (min) (TPH)***
Total Ash Generation considered at BMCR	45	125.55
Bottom Ash Collection	20	25.11
Economizer hoppers Ash Collection	3	3.76 (considered as 4 TPH)
APH Ash Collection	2	2.51 (considered as 3 TPH)
Duct Hoppers Ash Collection	2	2.51 (considered as 3 TPH)
SCR hopper ash collection	2	2.51 (considered as 3 TPH)
ESP Ash Collection	85	106.71
***The above break-up figures are not expected to occur simultaneous, but these distributions have been considered for design of various AHS sub-systems.		

4.02.00 Density of Ash

Design calculation	Density of ash (Kg/CuM)	
	Bottom Ash/ APH / Eco. / Duct hopper Ash	ESP Ash
For volume consideration	650	750 (For selection of pneumatic handling system for vessel sizing & silo capacity)

For load consideration	1600	1600
Particle Density for ash conveying systems	2000	

4.03.00 Maximum Velocity(m/sec) in Air & Water Lines

Service	Pipe sizes		
	Less than 50 NB	50 NB to 150 NB	200 NB & Above
Water pump suction	0.6-0.9	1.2-1.5	1.2-1.5
Water pump discharge	0.9-1.8	1.5-2.4	1.5-2.5
Compressed Air below 2 Kg/cm ² (g)	15 - 20	20 - 30	25 - 35
Compressed Air at 2 Kg/cm ² (g) & above	20 - 30	25- 40	35 - 45

4.04.00 Velocity in Slurry Lines

Min/ Max Velocity in Fly Ash Slurry Lines	1.8 to 2.8 m/sec.
Tip Speed for Ash Disposal Pump (Max)	1676 m/min

4.05.00 Friction Factor "C"

Friction factor ' C ' for Ash Slurry Lines	140
Friction factor ' C ' for Sludge Lines	130
Friction factor ' C ' for Water Lines	110

4.06.00 Basis for selection of effective capacities of various tanks / sumps

Description	Storage Time
Misc. Drain Sumps	10 min.

4.07.00 Design Basis

4.07.01 Bottom Ash System

Sl. No.	System	Design Criteria
1.	Bottom Ash Extraction System	Bottom Ash = 30 TPH (rounded off figure considering intermittent shoot blowing) To cater emergency evacuation of accumulated ash (8hr ash evacuation in hr time) Hence Bottom ash conveyor (extractor conveyor) shall be designed for minimum 60 TPH on dry ash

Sl. No.	System	Design Criteria
		basis

4.07.02 Fly Ash System

The Fly ash handling system capacity and equipment facilities shall be provided as under.

For system balancing, following arrangement may be envisaged.
One ash conveying line shall emerge carrying fly ash from two hoppers from each field (ie two from ESP first field, two from ESP send field, two from ESP third Field, two hoppers from FF 1st row, two hoppers from FF 2ndt row). Thus there will be total four number ash carrying pipes and conveying capacity of each pipe shall be around 46 TPH considering 8 hour ash being conveyed in 5 hrs including change over & down time(considering data from old units.)

Sl. No.	System	Design Criteria
1.	Fly Ash extraction and transportation System (Pressure Pneumatic)	ESP Fly Ash Generation, around = 106.72 TPH. Total FA Generation in a shift of 8 Hours = 854 T. Fly Ash Removal time considered in a shift of 8 Hours = 5 Hours (Excluding line purging, valve changing). No of stream=4 Fly Ash Removal Rate /stream= 45 TPH.(rounded off figure)

4.08.00 Pollution Consideration

Particulate Emission	Vent / bag filters shall be provided at logistic locations to arrest any sort of particulate emission in the ambient to restrict the SPM within permissible limit (sustained outlet dust emission shall be less than 30 mg/NM ³).
Noise Pollution	Average evaluated sound pressure levels shall be within 85 dB (A) measured at a distance of one (1) meter from the equipment concerned as per Noise Rating Curve ISO 85.

5.00.00 EQUIPMENT SPECIFICATION

5.01.00 Codes and Standards

Design, Manufacture, Inspection and testing of all the equipment shall comply with all the currently available statutory regulations and safety code in the locality where the equipment are to be installed. Other internationally acceptable standards, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the Contractor of the related statutory responsibility. In case of any conflict between standards and this specification, decision of the Owner/Consultant shall be final and binding.

5.02.00 After burning grate (ABG) (By SG Supplier):

After Burning Grate (ABG) shall function as post combustion device to ensure that the unburned residue in bottom ash from furnace is minimized thus enhancing the boiler efficiency.

5.03.00 Mechanical Seal:

Type: Dry Mechanical Expansion Joint. The mechanical seal shall be made of composite high temperature resisting materials and shall be able to withstand the boiler expansions and the pressures in the combustion chamber

Number: One (1)
Installation: Directly bolted to the boiler and the bottom ash hopper.
Capacity: Capable to absorb boiler vertical/horizontal expansion.
Size: According to boiler throat dimension.
Material: Multi-layer fabric joint.

5.04.00 Dry Bottom ash hopper

Number: Total one number.
Capacity: Each BA hopper shall be designed to hold BA generated in eight (8) hours under worst coal BMCR basis.

Design and Construction:

Hopper shell in carbon steel; internals lined with thermal insulation panels and refractory material and located between the boiler bottom & the dry bottom ash extractor and shall be supplied and designed by the Vendor. The bottom ash hopper shall be supported independently by its own supporting structure and shall be equipped with the mechanical seal at its top. During normal operation of the system there will be no accumulation of the ash in the bottom ash hopper and the bottom doors shall always remain open. The bottom ash hopper shall be equipped with poke holes, safe inspection windows, manhole.

The Boiler and the ash hopper center lines shall be offset to ensure that large lumps of ash fall on the hopper inclined side. The steel hopper casing with its internal insulation & refractory lining would be able to withstand the very high temperature of the furnace ashes

5.05.00 Bottom doors for bottom ash hopper

Quantity: Total one lot

Design and construction:

The Vendor shall provide the bottom doors between bottom ash hopper and dry bottom ash extractor. The Hopper Bottom Doors shall be hinged type, suspended on the hopper bottom part, to allow for ash storage below the boiler. Their upper part shall be refractory lined for protection against contact with the hot ash. The bottom doors system shall be operated with a hydraulic power unit containing 2 pumps (one in stand-by), with one actuation hydraulic cylinder for each door.

The bottom doors shall be swinging and used during maintenance work of downstream equipment. The operation of the bottom doors shall be easy and it will always remain open during normal operation.

The bottom ash hopper and the bottom doors system shall be designed in such a way that no obstructions will be present to the continuous ash flow, causing possibility operational problems and undesired ash accumulations below the boiler throat. Devices like crushing devices and impact beams for oversize ash lumps breakage shall not be located below the boiler throat, where high temperature will limit the expected performance and impede relevant maintainability in safe conditions for the operators.

5.06.00 Primary Carrying Conveyor (Dry bottom ash extractor)

Numbers provided: one

Capacity: as mentioned in specification

Design and Construction:

The primary carrying conveyor (bottom ash extractor) shall be provided, placed under the hopper and constituted by an air-tight steel casing and metallic conveyors: It has the function to collect, cool and convey to the downstream equipment the ash falling from the boiler.

The dry bottom ash extractor shall be able to operate continuously, and the capacity of which shall be not less than maximal bottom ash amount at boiler's BMCR including soot blowing condition. It shall also sustain with slagging ash, furnace running with major oil support, varying furnace draft. Conveyor speed shall be adjustable through VFD which shall automatically vary with ash loading/temperature. The extractor must remove continuously ashes from the bottom ash hopper. During normal operation, no ash must be allowed to accumulate in the bottom ash hopper.

The ash hopper side walls and components of dry bottom ash extractor shall be able to withstand high temperature and direct impact of large lumps of ash.

Conveyor shall be made of stainless steel and have overlapping steel pans to retain the bottom ash. The service life shall be not less than 5 years. All idler bearings shall be outside the enclosure to protect them from the heat and assure an easy maintenance.

During the transportation, the bottom ash is progressively cooled (combustion continues) due to the counter-current air, which is regulated via inlet valves into the extractor, and flows by natural draft due to the negative pressure inside the boiler. The airflow transfers the recovered energy back into the combustion chamber.

Cooling air rate to the dry bottom ash extractor shall be adjustable, and shall ensure that equipment operate safely and reliably.

The metallic conveyor shall have taken up arrangement at tail pulley either spring loaded type or automatic hydraulic loaded station or pneumatic automatic tensioning system.

Conveyor shall be capable of starting fully loaded.

Data Sheet:

A. General

- | | | |
|----|--|--------------------------------|
| 1. | Nos. required : | As indicated in Flow Diagram |
| 2. | Required capacity : | As per technical Specification |
| 3 | Conveyor speed | 0.01m/sec (Max.) |
| 4 | Conveyor Width | 1200 mm. (min) |
| 5. | Density of ash to be considered for designing structural and supports: | 1600 kg/cu.m |

6 All other accessories which not indicated specifically in this section shall be as per manufacturer std.

7. Earth quake zone designation as per IS:1893: As per site metrological

B. Material of Construction.

1. Conveyor pans : SS (tested quality) or equivalent.

2. Pulley & Idlers. : Stainless steel / Carbon steel

3 Casing. : Stainless steel / Carbon steel

4 Nut & Bolts : SS

5 Replaceable wear liners of gate: SS / Refractory

5.07.00 **Secondary Cooler Conveyor (Dry bottom ash conveyor)**

Numbers required: One (1) or as required

Capacity: As mentioned in specification

Design and construction

This conveyor shall be provided in an air-tight steel casing in which conveyors are located: a steel conveyor for bottom ash transportation and a suitable arrangement for fines removal from the casing floor. The dry bottom ash conveyor shall be able to operate continuously, and the capacity of which shall be not less than maximal bottom ash generation at boiler's BMCR including soot blowing condition. Speed shall be adjustable by VSD. The conveyor must further cool and convey bottom ash till downstream equipment.

Conveyor shall be made of steel. Conveyor shall be capable of starting fully loaded.

Cooling air rate to the dry bottom-eco ash steel belt conveyor shall be adjustable, and shall ensure that equipment operate safely and reliably.

The metallic conveyor shall have taken up arrangement at tail pulley either spring loaded type or automatic hydraulic loaded station or pneumatic automatic tensioning system.

DATA SHEET

A. General

1. Nos. required : As indicated in Flow Diagram

2. Required capacity : As per technical Specification

3 Conveyor speed 0.01 m/sec (Max.)

4 Conveyor Width 1200 mm (min)

5. Density of ash to be considered for designing structural and supports 1600 kg/cu.m

6 All other accessories which not indicated specifically in this section. :shall be as per manufacturer std.

7. Earth quake zone designation as per IS:1893 : As per site metrological

B. Material of Construction.

1. Belt pans : SS (tested quality) or equivalent.

3. Pulley & Idlers.: Stainless steel / Carbon steel

4 Casing. : Stainless steel / Carbon steel

5 Nut & Bolts : SS

6 Replaceable wear liners of gate : SS / Refractory

5.08.00

Pre-Crusher

The pre-crusher shall be provided at outlet of dry bottom ash extractor (Generally after secondary cooler conveyor or after Primary carrying conveyor).

The pre-crusher shall be composed of two jaws moving in opposite directions in order to crush big ash lumps with a few crushing cycles, avoiding ash lumps floating on the roller of the primary crusher.

The pre-crusher shall be activated by hydraulic cylinders and shall include the hydraulic unit.

Flexible connections between the dry bottom ash extractor and the pre-crusher and between the pre-crusher and the crusher shall be provided to damp vibrations.

DATA SHEET FOR PRE CRUSHER

A. GENERAL DATA

Number of crusher required : Two (1W+ 1S/B)

Capacity (dry ash basis) : Shall be selected as per capacity of the conveyor

Maximum particle size after crushing: To suit system/main crusher feed requirement

Duty : Continuous

B. MATERIAL OF CONSTRUCTION

Clinker crusher chamber : M. S. as per IS 2062, MIN 10MM THICK
Crushing element : 14% Mn steel, heat treated (BHN 500 minimum).
Liner/Anvil : Abrasion resistant Alloy C.I. or other suitable material (BHN 450 minimum)
Shaft : Alloy steel or equal.
Shaft Sleeve : S. S.

C. TESTING AND INSPECTION

No load running test at manufacturer's works : Yes
Performance test at site : Yes
All tests may be observed by Purchaser's representatives : Yes

5.09.00 Primary Crusher

Primary crushers (100% redundancy) shall be provided after the pre-crusher to reduce the size of the larger ash agglomerates and lumps. One crusher is in line, the stand-by one is located aside.

The crusher shall be complete with drive including motor, gearbox, transmission chain, couplings, base plates etc.

Flexible connections between the crusher and the dry bottom-eco ash conveyor shall be provided to damp vibrations.

Maintenance measure shall be considered in crusher arrangement. There shall be maintenance door at the crusher inlet side for inspection / necessary approach.

The crushers shall be installed on a movable trolley for easy change over from one to the other in case of maintenance.

DATA SHEET FOR PRIMARY CRUSHER**A. GENERAL DATA**

Number of crusher required : Two(1W+1S/B)
Capacity (dry ash basis) : Shall be selected as per capacity of the conveyor
Maximum particle size after crushing : To suit pneumatic conveying system requirement but not more than (-) 20mm
Duty : Continuous
Type : Double / Single roll, automatically reversible

B. DRIVE DATA

Drive motor by: Vendor

Starter by : Vendor

Drive motor : Electrical sub section (enclosed)

Type of coupling : Fluid coupling .

Protective guard for coupling : Yes

Protective guard for belt/chain : Yes

Reversing mechanism : Yes

Type : Automatic

Required elevation over
which drive motor
has to be mounted : Tenderer to indicate

Common base plate of drive motor and gear box : Yes

C. MATERIAL OF CONSTRUCTION

Clinker crusher chamber : M. S. as per IS 2062, MIN 10MM THICK

Rolls & Roll Teeth : 14% Mn steel, heat treated (BHN 500 minimum).

Liner/Anvi : Abrasion resistant Alloy C.I. or other suitable material
(BHN 450 minimum)

Shaft : Alloy steel or equal.

Shaft Sleeve : S. S.

Gland Packing: Graphite Teflon.

D. TESTING AND INSPECTION

No load running test at manufacturer's works : Yes

Performance test at site : Yes

All tests may be observed by Purchaser's representatives : Yes

5.10.00 Fly/bottom ash collection chute/ Hopper isolation valves (Knife Gate)

- a) Body : Cast Iron FG 260 to IS:210
- b) Gate : 10mm thick MS with minimum 35 microns of hard chrome on both sides/ SS with stellite to achieve hardness of 300-350 BHN.
- c) Seat : Integral seat/ Replaceable stainless steel hardened & smooth finished (250 BHN minimum).

- d) Body & seat hydro-test pressure 6kg/ sq cm or 2 times the working pressure, whichever is higher.

5.11.00 Dry Bottom Ash Storage Silo

5.11.01 Storage silo for dry bottom ash of capacity as per data sheet with adequate margins shall be provided. Storage silo shall be conical bottom type with the provision of vibrator at side wall. It shall have facilities for dry bottom ash unloading into covered road tankers and conditioned bottom ash in open road tankers.

5.11.02 Each dry bottom ash storage silo shall be provided with following arrangement for unloading the fly ash.

- a) A retractable chute along with rotary feeder for unloading the dry fly ash into closed road tankers at a rate specified in data sheet.
- b) A ash dust conditioner along with feeder for loading the conditioned ash into open road tankers at a rate specified in data sheet. It shall be possible to vary the water supply depending upon ash flow rate. However max moisture content in the ash shall be limited to 20%.
- c) Two blank opening for bottom ash slurryfication arrangement though HCSD in future

5.11.03 The storage silo shall be designed to provide a clear headroom of 5.5m (from paved floor level to Bottom of Silo beam) for a road tanker to come under the silo and receive the ash from the retractable chutes. To facilitate locating these chutes over the road tanker opening, it shall be possible to move the chute in all directions in the horizontal plane. It may be noted that unloading system from Silo shall be suitable for both closed tanker/open truck unloading. Silo layout and column location shall be suitable for accommodating two vehicles for simultaneous loading of ash.

5.11.04 Each retractable chute shall include a shut off device at the silo outlet, a level probe to determine the level of ash within the road tanker, dedusting and vent air systems, and a motor operated winch system to lower/raise the chute. Retractable chute/Dry ash unloader shall be sourced from reputed manufacturer(s), whose bulk loading spouts/retractable chutes have established field provenness. The unloading chute shall have vent fan with bag filter in suction connected to the tanker to take the displaced air and discharge in clean manner.

5.11.05 Details of the pressure/vacuum relief valves provided in the storage silos shall be furnished along with the bid.

5.11.06 Instruments

Each silo shall be provided with following instruments as a minimum :

- a) Silo ash level transmitter 1 No.
- b) Level switch with the telescopic chutes
(meant for unloading into closed tankers): 1 No.
- e) One level switch for high level detection

5.11.07 The bidder shall include any other instrument required to make the system safe, efficient and reliable.

Rotary Drum Unloader cum dust Conditioner

The rotary Drum unloaders cum conditioners are located below the silo opening on an intermediate level concrete platform such that trucks can move freely underneath it. At the inlet of the rotary unloader there shall be a variable capacity feeder which can be controlled. These feeders accurately control the discharge of the silo into the unloader. At the upstream of the orifice feeder there shall be cylinder operated knife gate valves. Each unloader shall be sized for 120 TPH of dry fly ash. The unloader inlet section is stationary and provided with a seal between the revolving drum & the inlet section. The drum will be provided with suitable guards to ensure operators' safety. Scrapper plate shall be of steel construction lined with special wear resistant alloy. There shall be expansion joint provided on the unloader to eliminate distortion & uncontrolled field variations. There shall be access doors to all parts of the unloader e.g., inlet section of the drum & discharge box.

5.12.00 Water and Air Piping, Fitting and Accessories

All piping shall be provided with vents at the highest points and drains at the lowest points along with vent valves and drain cocks. Vents shall not be less than 15mm in size. Drains shall not be less than 25 mm size.22.7. The piping shall be arranged to provide clearance for the removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance.

5.12.01 Piping shall generally be routed above ground but where specifically indicated/approved by the Engineer the pipes may be arranged in trenches or buried. Bidder shall provide either coal tar and Bitumen tapes on conventional coat and wrap system for corrosion protection of buried piping as per relevant codes and standards.

5.12.02 Overhead piping shall have a normal minimum vertical clearance of 3 meters above walk ways and working areas and 8 meters above roadways unless otherwise approved by the Engineer.22.10 Pipe Size in pump suction side shall be at least one pipe size larger than the corresponding pump discharge connection.

5.12.03 The pipe supports shall be spaced as follows :

Pipe size(NB)	25	50	80	100	150	200	300	400	500
Spacing in metre	2.1	3.0	3.7	4.3	5.2	5.8	7.0	8.2	9.1

Data Sheet of Water and Air Piping, Fittings and Accessories

(As per specification indicated elsewhere suiting the service requirement)

WATER PIPES			
1.0	Type of Pipes	a) Upto & including 150 NB	MS, ERW pipes to IS:1239 Heavy grade
		b) 200 NB to 450 NB	MS ERW to IS 3589. FE 410 grade.

		c) 500 NB and above	Rolled and welded from MS plate to IS:226 Dimensional tolerance as per IS:3589. or SAIL or Equal make spiral welded pipes.
2.0	Pipe Sizes	As required.	
3.0	Thickness of Pipes	a) Pipe specs. as per IS:1239	Pipe thickness shall be of Heavy grade.
		b) Pipe spec. as per IS:3589 (ERW)	Minimum 6.35 mm thick for 200 NB to 400 NB size and Minimum. 7.14 mm thick for 450 NB size.
		c) Pipe spec. as per IS:3589 (ERW) from IS 226 plates/spiral welded	Minimum. 8mm thick
4.0	Type of Line joints.		
		a) 50 NB and below	i) Socket welded to ANSI:B16.11. for high pressure application. ii) Butt welded as per ANSI B 16.25
		b) 65 NB and above.	Butt welded to ANSI:B16.25.
5.0	Quantity	As required	
6.0	Fittings (Bends)		
		a) For sizes upto & including 65NB	Short radius bends and material same as that of parent pipe.
		b) For sizes 80 NB to 300 NB	Standard elbow and material same as that of parent pipe
		c) 350 NB & above.	Miter bends with Miter angle not exceeding 22.5°. Material shall be same as that of parent pipe and dimensional tolerance shall be as per BS : 534.
7.0	Flanges	Slip on flat face type with drilled and pressure rating as per valve and other specialties. Material of construction shall be as per IS:2062.	

5.13.00

Water And Air Line Valves And Specialities (As per specification indicated elsewhere suiting the service requirement) . For fluidizing air line valves design and construction shall take special consideration for temperature of service fluid.

Data Sheet Water and Air line valves
Gate/Globe/Check Valve

For sizes 50 mm and below and working pressure up to 15 Kg/cm ² (g)	
Body/Wedge/Disc	Gun Metal
Trim & Seat	Gun Metal
Stem	Brass
For sizes 65 mm and above and working pressure upto 15 Kg/cm ² (g).	
Body/Wedge/Disc	C.I. to IS 210 Gr. FG 260
Trim & Seat	SS/ Gun Metal
Stem	SS 410
Hand wheel	C.I. to IS 210 Gr. FG 220
For all sizes and working pressure above 15 Kg/cm ² (g).	
Body/Wedge/Disc	Cast/Forged carbon steel
Wedge/Disc/Plug	Cast carbon steel with 13% Cr lined
Trim and Stem	Stainless steel
Quantity	As required.

Butterfly valve (Design Standard: BSEN 593-2004/AWWA-C-504)

Body	CI FG 260 IS 210/CS ASTM A 216 Gr WCB/Eqv
Trim/Spindle	SS ASTM A 479 Type 316/410
Disc	SG iron BS 2789 Gr 500/7 or SS ASTM A351, Gr CF8/eqv
Hand wheel (in case of manual operated valve)	CI FG 220 IS 210/CS IS 2062. Gr A
Test Pressure	Hydro and air test pressure will be as per selected rating of valve. However Hydro test pressure of shell/body should not be less than twice of working pressure.

Plug Valve

Body	CI FG 260 IS 210 or Carbon Steel ASTM A216 Gr WCB
Plug	CI FG 260 IS 210 or Carbon Steel ASTM A216 Gr WCB
Test Pressure	Hydro test pressure will be as per selected rating of valve. However Hydro test pressure of shell/body should not be less than twice of working pressure.

Note (1)	For slurry and ash contaminated water lines, Recovery water lines, regular pattern plug valve to be provided.
Note (2)	For Diaphragm operated pressure switch, pressure gauge isolation, 40 NB regular pattern plug valve to be provided.

Ball Valve (upto 150 Nb only, Design Standard: BSENISO 17292):

Body	Carbon Steel ASTM A216 Gr WCB
Ball/Spindle	ASTM 276 Type 304 / ASTM A 351 Gr. CF8M
Stem & Gland	AISI 316

5.14.00 **Manual/ Pendant Overhead Travelling Cranes**

In case of any conflict in the standard and the specification, the bidder/ contractor shall comply with the following requirements.

Design & Construction Requirements

- 5.14.01 An adequate capacity crane is to be provided in ash water pump house, compressor house and combined ash disposal pump house, vacuum pump house & other areas as mentioned in specification for handling the equipments installed there in for routine maintenance purposes. The capacity of the hoist shall be kept 125% of the heaviest part to be handled during erection and maintenance.
- 5.14.02 The overhead travelling crane shall be suitable for manual operation from pump-house floor level. Hand chain shall be provide for long travel of bridge. The hoisting mechanism and cross travel of trolley shall be pendant controlled electrically operated (suitable for operation from pump house floor level).
- 5.14.03 The capacity, span, crane runway length and lift of the crane shall be to suit actual size of the building, layout of the equipments within the building and weight of the equipments to be handled. The details of building size, equipment layout and weight of the equipments shall be worked out by the bidder and furnished to owner for review.
- 5.14.04 In the design of components on the basis of ultimate strength, factor of safety shall not be less than 5 (five) impact, fatigue, wear and stress concentration factors shall be taken into account wherever applicable. The structural design shall be as per IS:807-1976.
- 5.14.05 All materials shall be of tested quality and shall conform to the specification requirement and standard mentioned, and shall be of recent manufacture, Combustible materials shall not be used.
- 5.14.06 Castings and forgings shall be of tested quality and shall conform to their respective material specification, and shall be free from flaws, mill scales, laminations, pitting, flakes, rust, etc. and shall be mentioned true in a workman like manner.
- 5.14.07 All fabrication by welding shall be carried out by certified welders as per IS:1181-1967, or equivalent. Welding practice and procedure shall be as per the stipulations

of IS:816-1967, IS:823-1964 and IS:1323-1966. All welds shall be free from defects like blow holes, lack of penetration, slag intrusion etc.

5.14.08 Crane Bridge

The crane bridge shall consist of a single or double bridge girder, carrying to two wheels at each end of the span.

The materials of construction for bridge girder shall be structural steel. Plates of thickness 20mm and above shall conform to IS:2062

There shall be two trucks per crane, i.e. one truck running on each track. Each truck shall have two wheels. Trucks shall be of all welded construction fully enclosed, box type design providing easy access to the bridge wheels for examination or maintenance.

The long travel bridge wheels shall be double flanged as per IS:3177-1977 and provided with antifriction bearings. The wheels shall be machined on their treads to match with the runway rail/square bar section. The axles and shafts shall be accurately machined and properly supported. There shall be geared shaft and pulley, connected to the axle of one bridge wheel by means of which long travel motion of the bridge assembly shall be conducted by the operator from the floor with the aid of a hand chain.

The bridge wheels shall be of cast steel/forged steel rim toughened. The wheel axle and shafts shall be made of EN-8 carbon steel. In case of wheel fracture suitable jacking pads shall be provided for wheel replacement.

Specified length of runway rails/square bar section shall be included by the Bidder in his scope. The runway rail/bar shall be erected and fixed by the Bidder on the building structural work.

5.14.09 The following accessories shall also be furnished for bridge travel

- a) Rail clamps (as applicable), Accessories for mounting and fixing of runway rails on steel/RCC crane girder.
- b) Suitable steel stops at each end of the bridge girder together with the end stops with rubber type buffers at each end of runway rails.
- c) Anchor bolts, nuts, sleeves and inserts wherever applicable.

5.14.10 Travelling Trolley

The trolley carrying the hoist will travel on the lower flange of the bridge girder (I-Beam) furnished by the Contractor. The bridge girder shall have enough strength to carry the test load without causing undue stress or deflection.

The trolley frame shall be made of structural steel to IS:2026.

The trolley track wheel shall be single flanged and shall have antifriction ball bearings. The wheel shall be machined on the treads to match the flange of the track joint.

The wheel shall be rim-toughened and of cast steel/ forged steel construction. The wheel axle and shaft shall be made of EN-8 carbon steel. The tread and the flanges shall be hardened to 250-300 BHN for longer life.

The side plates of the trolley assembly shall extend beyond the wheel flanges, thus providing bumper protection for the wheels. The two side plates shall be connected by means of an equalising pin.

The trolley drive mechanism shall be pendant controlled and shall consist of an electric motor driving through reduction.

5.14.11 Hoisting Mechanism

The hoisting machinery shall consist of an electric motor with an approved type of brake interposed in the hoisting gear train as close to the source of power as possible.

Hoisting mechanism shall also be furnished complete with shafting, flexible couplings, and machined grooved drums, wire ropes, and hoisting blocks. All bearings used shall be self aligning ball/roller type.

The hoist motor shall be of proper size to hold 125 percent test load and control the speed of lowering under all conditions.

Drum shall be as per relevant crane standard fabricated out of tested quality mild steel plates of fusion welding quality as per IS:2062 (latest revision). The welds shall be duly tested and the drum measured at the bottom of the groove shall not be less than the diameter specified in IS: 3177. Larger diameter will be preferred. Drum shall be flanged at both the ends. When the rope is fully wound on the drum, the flanges shall project to a distance not less than two rope diameters. There shall be not less than two dead turns at the anchored end in addition to the length of rope required for the specified lift. Rope anchorages shall be readily accessible.

5.14.12 Wire Ropes

Wire ropes shall be of round stranded extra soft plough steel wire construction and designation complying with IS:266. Arrangement entailing reverse bends shall be avoided. Eye splines, sockets, thimbles and ropes anchorage shall be designed, so as to be capable of withstanding 90% of the guaranteed breaking strength of the rope to which they are attached.

5.14.13 Rope Sheave

Sheaves shall be made of Cast steel/forged steel with self aligning bearings. Sheaves shall be machined smooth and suitably guarded with rope retainers to prevent accidental removal of ropes from grooving. Hook block sheaves shall be of sufficient spread to prevent rope twist and shall be suitably guarded.

Equalising sheave shall be arranged to turn and swivel freely in order to maintain rope alignment under all circumstances.

5.14.14 **Pendant System**

The pendant system shall be complete with the following provisions

Pendant controls shall be provided with the pendant fixed on bridge. The push button control shall be of spring type and shall automatically return to OFF position immediately after it is released.

The pendant control shall be suspended with the help of chain of wire rope and pendant shall be effectively earthed.

The suspension arrangement shall run sufficiently clear of the hoisting block assembly and suspension hand chain for long travel motion to prevent fouling.

The pendant control shall be provided with push button control for hoisting, lowering, cross-travel and power 'on-off'. Indication lamp shall be provided to indicate 'Power supply on'.

The pendant shall be energised through 240V AC supply. Necessary 415/24V step down transformer and associated wiring and other electricals for the pendant control circuit shall be furnished by the Contactor.

Contractor used for control system shall be crane duty with current rating not less than connected motor full load. All reversing contactors shall be mechanically and electrically interlocked.

5.14.15 **Cabling & Wiring**

All wiring shall be done with 650/1100 V grade PVCA/PVC cable with extruded inner sheath. Cable conductors shall be stranded Aluminium for power & stranded copper for control. Minimum conductor size shall not be less than 2.5mm² copper or equivalent. The flexible cable of C.T. motors shall be sheathed butyle rubber or equivalent.

5.14.16 **Electric Motors**

The drive motors of hoist drive and cross travel shall have the following design features.

The motor shall be TEFC, wound rotor slip ring type &quirrel cage type, with class 'B' insulation suitable for operation on 415V $\pm$ 10% 3 phase, 50 Hz supply.

The motors shall be linearly rated for the duties and speed involved. The rating shall suit cyclic duration factor of 25% and number of cycles per hour as 150.

The motors shall be suitably braced and insulated for heavy shocks and vibrations and a maximum speed of 2.5 times the rated speed.

The motors shall be provided with suitable fuses for short circuit protection.

5.14.17 **Service Brakes**

The service brake for hoist motion and cross travel drive shall have the following design features.

One electromagnetic or D.C. disc. type brake each shall be provided for hoist drive and cross travel drive. The hoisting brake for hoist shall be; rated for 150% of full load torque requirement.

The brake shall apply directly to the motor shaft and shall be equally effective on both directions.

The brakes shall apply automatically when power to drive motor is cut off or fails.

5.14.18 **Bridge & Trolley Conductors**

The bridge conductors shall be of M.S. angles and steel blocks type sliding over steel angles. Alternately Festooned cable arrangement of suitable design as approved by the Owner may be provided. Convenient means of access shall be provided for maintenance of all the collectors. Necessary provisions shall be made for expansion of the steel conductors. Collector gear shall be rigidly mounted so as to provide reasonable accessibility to all parts for maintenance purposes. Collector leads shall be readily renewable and shall be positioned so as to provide adequate contact with the conductor for any position of the bridge. Trolley collectors shall be of festooned cables, suitably guided and supported.

Sufficient allowance shall be kept for wear and tear while selecting size of angles. Necessary insulators, supports, etc. shall be furnished by the Contractor.

Power Collectors shall be of sufficient area for rated current and shall maintain adequate contact pressure. Spacing between power collector shall be such as to provide sufficient quenching area for sparks coming out from collector surface.

5.14.19 **Limit Switches**

All necessary limit switches to prevent over hoisting, over lowering and over transvering shall be provided. Details of their location, type, rating and working arrangements shall be furnished for approval.

5.14.20 **Earthing**

The crane structure, motor frames and metal cases of all electric equipment, including metal conduits or cable armoring or guards shall be efficiently bonded to facilitate earthing and earthing terminals shall be provided as per the relevant Indian Electricity Rules/Codes.

The crane grounding system shall be connected to the earthing provided by the bidder.

5.14.21 Hooks

The lifting hooks shall conform to IS:3815. Hooks shall of solid forged heat treated alloy steel construction, plain shank type. The hook shall be supported on a thrust bearing with hardened races. The hook shall also swivel freely on its bearing. Locks to prevent hooks from rotation shall also be provided.

5.14.22 Bearings

The type of bearings for various parts shall be as per IS: 3177.

Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as practicable to exclude dirt and prevent leakage of oil and grease.

Suitable drip pans shall be provided as required to collect oil and grease which may drop from operating parts. All drip pans shall be accessible for draining and cleaning.

All bearings of the gearing shall be of antifriction type.

5.14.23 Hand Chain

The hand chains for the longitudinal mechanism shall hang well clear of the hook. The hand chain wheel shall be made from pressed sheet steel and shall be provided with roller type guarding to prevent sagging or fouling of the chain.

5.14.24 Couplings

All couplings shall be flexible geared type suitable for crane duty specified.

5.14.25 Gearing

All the gearing shall conform to BSA 36 and/or BS:721/IS:4460/3938/3177, and shall be totally encased. Proper lubricating arrangement shall be provided for gearings and pinions. Gears shall be cut from forged steel blanks or heat treated alloy steel. Face pitch, designing, manufacture and testing of gears shall be in accordance with BS:436 and/or BS:721 or BS:545 or IS:4460/3938/3177

5.14.26 Lubrication

The bridge, hoist and trolley shall have facility for lubrication of the moving parts with convenience.

All working parts shall be readily accessible for inspection, renewal, repair and Lubrication.

5.15.00 Fly ash collection chute/ Hopper isolation valves (Knife Gate)

- a) Body : Cast Iron FG 260 to IS:210
- b) Gate : 10mm thick MS with minimum 35 microns of hard chrome on both sides/ SS with stellite to achieve hardness of 300-350 BHN.

- c) Seat : Integral seat/ Replaceable stainless steel hardened & smooth finished (250 BHN minimum).
- d) Body & seat hydro-test pressure 6kg/ sq cm or 2 times the working pressure, whichever is higher.

5.16.00 **Ash Transporter/Air Lock/Pump Tank**

- a) The vessel shall be designed for not more than one lakh cycles of operation annually for the specified ash evacuation rate.
- b) Ash transporter/air locks/pump tanks shall be provided with necessary inlet and outlet valves of the type specified elsewhere in the specification.
- c) The ash transporter /air locks/pump tanks vessel shall be constructed with tested quality mild steel plates as per IS:2062. They shall be able to withstand the abrasive action and hot condition of fly ash. The Ash transporter /Air locks/pump tanks shall be supported independently on steel columns or hanger support.
- d) A full explanation to the air lock/pump tank operation cycle shall be supplied with the tender, listing all operations i.e. loading, fluidizing, and discharging. Calculation justifying size of venting connection is to be provided by Bidder.
- e) Aeration pads, if felt necessary by the bidder to assist the flow of ash through the air-lock valves shall be provided.

Data sheet : Air locks / pumps tanks

Design pressure	1.5 times the design pressure of associated Air Blower/ Compressor or 2 times the operating pressure whichever is higher. Design calculations shall be submitted for Owner's approval
Material of construction	Tested quality IS:2062
Nos. provided	One working set and one standby set for each Combination filter Separator cum buffer hopper.
Aeration pads	As per requirement (Ceramic tiles)

5.17.00 **Data Sheet Of Horizontal Centrifugal Pumps**

Description	Ash slurry disposal pumps, and sludge pumps	HP, LP, Seal water, Pumps, Dust conditioning water pumps, Flushing water pumps and other horizontal water pumps.
Type	Horizontal, single stage centrifugal type(all identical pumps shall be interchangeable)	Horizontal, single or multi stage centrifugal type (all identical pumps shall be interchangeable). Horizontal split casing for single stage and multistage pumps.
Duty	Continuous	
Fluid to be pumped	Highly abrasive slurry. Pump shall be designed to handle maximum ash lump size expected at the outlet of clinker grinder	Raw Water/Clarified
Parameters:- Flow & Head	As per design guidelines contained in accompanying specifications	
Suction condition	Flooded suction with suction lift of 2m	
Pump speed (max.)	1,000 rpm	1,500 rpm
Impeller tip speed	1676 meters / min. (max.)	As per mfr. Std.
Type of coupling	Variable speed Hydraulic coupling with speed reduction by means of speed reduction gear box in first stage. Speed variation +10% - 45% with respect to rated design point in case of ash disposal pumps For the subsequent stage through belt drive.	Directly driven through coupling.
Material of construction		
Casing	Outer casing shall be of cast steel to ASTM-A216 or spheroidal Graphite Ductile iron to ASTM-A-536, 65-45-12. Inner casing (Volute liners) shall be of chrome nickel cast iron (composition to NI hard-IV) of 550 BHN. Or 24% chromium cast iron of 550 BHN. BA overflow pump : CI FG 260(in case single casing pump)	Cast Iron to IS:210, Grade FG-260.

Impeller	Chrome nickel cast iron (composition to NI-hard IV) of 550 BHN Or 24% chromium cast iron of 550 BHN.	Bronze Gr.I to IS:318/SS
Wear plate / liners wear rings	- do-	Bronze Gr.I to IS:318/SS or equivalent.
Shaft	Carbon steel to AISI -1040 / EN-8	Carbon steel to AISI K-1040/ EN-8
Shaft Sleeve	Hardened and ground stainless steel (550-BHN) SS 410 BHN for BA overflow pump	As per manufacturer standard.
Base plate	Steel to IS:226 upto 20mm thickness and IS:2062 and over 20mm thickness.	
Drive motor rating	15% margin over and above the maximum load demand in the entire operating range of pump at 50 Deg. C. 10% for water pump with HT drives & 15% with LT drives.	
Drive motor speed	Not exceeding 1500 rpm	
Note	Reducer at suction side, if required, preferably be eccentric type (for all application).	

5.18.00 Vertical Sump Drainage Pumps : As per specification incorporated elsewhere and suitable for handling abrasive slurry.

Data sheet of Vertical sump drainage pumps

Sl. No.	Description	Sump drainage pumps for vacuum pump house area, Silo area, Slurry sump area and other area as per flow diagram
1.	Type	Vertical, Centrifugal, single stage, semi-open or (open non-clogging) type impeller.
2.	Duty	Intermittent, However, to be designed for continuous operation.
3.	Fluid to be pumped	with 30% particles by weight
4.	Capacity and total dynamic head (Guaranteed)	Bidder to decide
5.	Suction Condition	Submerged
6.	Number of pumps	As per flow diagram
7.	Pump speed (Max.)	1500 rpm (Max.)
8.	Type of coupling between pump & Motor	Directly driven through flexible or rigid coupling/V-belt driven

9.	Location of pump thrust bearing	In Motor Stool
10.	Material of Construction	
	a) Casing	Alloy cast iron (350 BHN) (Min 2.7% Ni; 1% Cr.)
	b) Impeller	Alloy cast iron (350 BHN)(Min 2.7%, Ni, 1% Cr.)
	c) Impeller shaft	Stainless steel -410
	d) Line shaft	EN - 8 to BS:970
	e) Column pipe and discharge pipe	Fabricated steel to pipe IS:2026 (Minimum 6 mm Thk)
	f) Shaft sleeve	Hardened stainless steel to 400 BHN
	g) Base plate	Steel to IS:2062
11	Motor details	
	Rating	Shall be sized as per guide lines in Tech specifications
	Speed	1500 rpm(max)

5.19.00 Bag Filters

- 5.19.01 The bag filter unit shall be placed above all the /silo.
- 5.19.02 Gross Face velocity (considering 10% bag plugged condition) FOR BAG FILTER should never exceed 1m/min.
- 5.19.03 The performance of the bag filter shall not get affected with 10% of the bags plugged. The material of bag shall be capable of continuous exposure of temperature 150°C min and momentary contact 170°C.
- 5.19.04 The bag filter unit shall be designed to achieve as sustained outlet dust emission limited to 30 mg/NM³ (maximum).
- All bag filters shall be supplied complete with automatic pulse jet bag filter cleaning equipment with all necessary instrumentation including diff. Pr gauge, diff pr switch, solenoid operated pulse valve.
 - Clean air plenum on bag filter with clear man height shall be provided for easy access of bags for maintenance. Bag filter manhole shall have easy access through platform/stair etc.

5.20.00 Air Compressors for Pneumatic Conveying of Ash

- Air compressors shall be designed for continuous operation with high efficiency to satisfy the system requirements. Satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, noise etc.
- The design shall incorporate every reasonable precaution for the safety of all operation and maintenance personnel. Each compressor unit should have all moving parts protected by a guard.

- c) The scope of supply shall include all the necessary compressed air system complete with compressors, coolers, necessary isolating and non-return valves, pressure relief valve, water separators, silencers and vent pipe work.
- d) In order to have flexibility in operation the compressor discharge shall be interconnected with suitable valve arrangement.

5.20.01 Ash transportation lines shall be provided as per single line flow diagram.

- a) The capacity of transport air compressors shall be decided to match the capacity of extraction system i.e. the capacity of extraction and transportation system shall be similar.
- b) The bidder shall furnish detailed calculations of compressor sizing along with the bid.
- c) All air compressors and their drives provided under shall be completely interchangeable.
- d) Unless, inconsistent with this specifications, equipment from the standard range of manufacture shall be preferred.
- e) Each compressor shall have an inlet filter of dry type to protect the compressor. The filter inlet area should be large enough to ensure frequent filter changes are not required.
- f) Cooling water requirement, if any, should be furnished along with the bids. The cooling water supply shall be given by the Owner at one point only.
- g) Bidder shall include an inlet and/or outlet silencer so that each compressor unit complies with the noise requirements outlined in Specification.

5.20.02 Water Separators

The Bidder shall supply water separators complete with automatic drain traps. Each separator shall be rated for twice the individual compressor flow at 1 bar above maximum operation pressure. Each water separator shall have flanged connections.

5.20.03 Drive Motor

- a) Drive motor shall be connected to the Air compressors directly or through any suitable type of power transmission system.
- b) The continuous motor rating (at 50°C ambient) shall be at least ten percent (10%) above the maximum load demand of the compressor in the entire operating range to take care of the system frequency variation. Total maximum load demand shall include air compression power plus any power consumed in auxiliaries like cooling fan etc. When the driver is not directly coupled to the compressor, due account shall be made for losses in power transmission in addition to the above 10% extra margin.
- c) The bidder shall include all instruments required to make the system safe, efficient and reliable.

Data Sheet : Transport Air compressor(oil free screw type preferable)

Sl. No.	Description	Details
	Compressor	
	Location & Type	Indoor, Screw Type compressor/
	Number:	As per flow diagram
	Applicable Codes	BS:1571(Part I & II), IS:6206, IS:5727, ASME power test code PTC 9., IS 5456 , ISO 1217
	FAD of each set of working compressors at ambient conditions	Sufficient to meet the ash removal @as mentioned in specification
	Design conditions	50° C & 100 % RH
	Site ambient conditions	Refer project information.
	Type of cooling	Air/water [for water cooling -DM close cycle cooling water system to be employed, Type of water-passivated DM water Or Clarified water(as per existing system)
	Duty	Continuous
	Type of intake filter	Dry type
	Dryness of air	Air temperature to be maintained above the dew point throughout the conveying process till silo.

5.21.00 Fluidising Air Blowers

- The blowers shall be oil lubricated and preferably air cooled.
- The Blowers shall be constant volume/positive displacement type and each blower shall be provided with suction filters, pressure relief valves with the corresponding vent pipe work, necessary isolating and non-return valves, inlet and/or outlet silencer so that blower unit can comply with the noise level requirements outlined in General Technical Conditions and all other accessories of drive and mounting For ESP; As per flow diagram.
- Necessary heating arrangement with a suitable bypass shall be provided at the discharge of the blowers to raise the temperature of aeration air to a temperature of at least 150°C. Schemes shall also include for thermal insulation of all air pipe work from the blower/heater outlet to the point of contact of fly ash.
- All air blowers and their drives provided under this contract shall be completely interchangeable.

Data Sheet Of Aeration Blowers For Esp Hopper, & Silo

Purpose	For fluidising the ash in Silo, ESP hoppers.
Quantity	One(1) working + One (1) standby for ESP hoppers for each unit for ESP HOPPER, BUFFER HOPPERS. For Silo 3 no (2 working , one for each Silo and one common stand by)
Design	Fluidising Air Blower to be provided. Positive displacement type to meet the aeration air requirements of fly ash hoppers and buffer hoppers. A 10% margin on capacity shall be provided over and above the maximum requirement.
Duty	Continuous, outdoor
Design condition	: 50°C and 90% RH

Material of Construction

Casing	CI Gr. 260 to IS:210
Shaft	EN 8
Rotors	CI Gr. 260 to IS:210
Piping	MS ERW as per IS 1239/3589, insulated to limit surface temperature to 60°C.

Following Instruments shall be provided

- | | | |
|-----|---------------|-------|
| (a) | Pressure | 1 No. |
| | gauge at the | |
| | blower outlet | |
| (b) | Pressure | 1 No. |
| | switch at the | |
| | blower outlet | |

Note-1 For ESP Fluidising Blower selection continuous fluidizing of all pads of Minimum first & second field ESP Hoppers is to be considered.

Note-2 For silo Fluidising , 14% of area of silo is to be covered with fluidising pad and all pads to be provided with fluidising air continuously.

EQUIPMENT SPECIFICATION SHEET FOR FLUIDISING AIR HEATER

1.00	Application	Hopper (ESP/ / Silo)Fluidizing Air Heating
2.00	Working Atmosphere	Heavily dusty, tropical, power plant atmosphere.
3.00	Design ambient dry bulb Temperature	45 Deg.C
4.00	Whether exposed to direct rain and sun	Outdoor / Under Shed
5.00	Type	Electrical, (heating elements shall be segregated into two banks).
6.00	Quantity Required	As per P & I D
7.00	Rate of Air Flow	As per Blower parameter
8.00	Air Pressure	Based on Blower parameter.
9.00	Inlet Air Temperature for design purpose	Outlet temperature of Blower considering minimum ambient temperature specified at blower inlet.
10.00	Design Outlet Air Temperature	To suit system requirement to maintain the discharge temperature of the air at least 50 Deg.C above the water vapour dew point but not less than 150 deg centigrade.
11.00	Type of Duty	Continuous operation
12.00	Supply Details	415 V $\pm$ 10%, 50 Hz $\pm$ 5%, combined variation $\pm$ 10%, 3 phase, 4-wire, effectively earthed system
13.00	Air Heater Load Condition	Balanced three (3) Phase
14.00	Insulation between heating element body and supporting plate	Secondary Insulation Bushing
15.00	Temperature indicator	
a)	Type	Bimetallic type/ equivalent
b)	Size	150 mm dial
c)	Range	To Suit duty Condition.
d)	Quantity required for each air heater	Two (2) nos. One on inlet and other on outlet side for each heater.
16.00	Temperature Switch	To be provided for each heater where number of heaters working is more that one.
a)	Type	Bidder to indicate for approval
b)	Contact rating	3 amps. at 240V A.C
c)	Suitable for cutting off heating element individually	Yes
d)	Quantity Required	One for each heater
e)	Range	To Suit duty condition
17.00	Temperature Element	
a)	Type & Make	Bidder to indicate for approval.
b)	Range	Bidder to indicate for approval
c)	Quantity required for each Air Heater	One (1) no at common header of heater
18.00	Indicating Lamp	
a)	Quantity Required	One (1) for each heating element
b)	Location	Integral with the body of heater

c)	Indication	Heater 'ON' / 'OFF'
The bidder shall include any other instrument required to make the system safe, efficient and reliable.		
19.00	Terminal Box	
a)	Location	Bidder to indicate
b)	Withstand capability for fault level	50 KA (each) at 415 V unless specified otherwise
c)	Power Cable details	To be furnished during order finalization
20.00	Earthing	
a)	Type	Bolted Type
b)	Locations	Two (2) nos. on opposite side of the base of Air Heater Assembly One (1) no. on terminal box.
c)	Details of Earthing Conductor	8 SWG Galvanized Iron Wire
21.00	Whether cable gland and lugs are in scope of supply	Yes
22.00	Mounting bracket included in scope of supply	Yes
23.00	Testing	
a)	Hydraulic Test Pressure of shell	5.0 Kg/cm ² g
b)	Air leak test pressure of assembly	1.5 Kg/Cm ² g
24.00	Thermal Insulation	At the heater internal and external surfaces - such that the external cladding temperature is not exceeding 60 Deg. C. Insulation (mineral wool) material density during application not less than 150 Kg/ Cu. m

5.22.00 Instrument Air Compressors And Drives

Instrument air compressors are in owners scope. Bidder shall extend it from terminal point at unit-3. All arrangements beyond tapping point including valve, pipis, instruments, supports, air lubricator cum regulator, alarm for low pressure, clubbing the signals in control room etc for smooth system operation shall be in bidder's scope

5.23.00 Air Receivers

03 nos Air receiver tank already existing, but not in service. Bidder to check condition of same, do necessary recitations and TPI certification before taking into service. Bidder shall do all piping, valves, pipe supports, instrumentations, drain trap arrangement etc as per requirement.

5.25.00 TECHNICAL SPECIFICATION FOR AIR DRYING PLANTS (Refrigerant Type) (for Conveying Air Compressor)

A CODES AND STANDARDS

The design, manufacture, testing and performance of the various components of Air Drying Plant shall comply with at least the requirements of one or more of the following codes, as applicable :

- i) IS-11989 : Specification for Air Dryers.

- ii) IS-2825 : Code for Unfired Pressure Vessels.
- iii) IS-11327 : Requirement for refrigerent condensing type units
- iv) IS-5111 : Testing of refrigerent compressor
- v) ISO 8753.1 : Filter quality classes

B. GENERAL PERFORMANCE REQUIREMENTS

- 1.00 The air drying plants receiving compressed air saturated with moisture shall be capable of operating continuously to provide reliable moisture free compressed air. Dew point of the outlet air shall be as mentioned in the Data Specification Sheet or lower throughout the operation.
- 2.00 The delivered compressed air shall not contain any trace of oil, grease or any other impurities and air shall be free from all corrosive contaminants and hazardous gages, flammable or toxic. Size of particles in the delivered air shall not exceed one (1) Micron. The delivered air shall be 100% oil free.
- 3.00 For calculating moisture load, relative humidity and dry bulb temperature at ADP inlet shall be taken as 100% and 50 deg.C respectively.
- 4.00 The drying process shall employ the refrigerent system to remove moisture from air.
- 5.00 For the capacity and air flow rate through drier, the data specification sheet shall be referred to.
- 6.00 Air drying plant shall be complete with pre and after filter including all pipings, valves, instruments and other, accessories as required for safe and satisfactory operation of the plant.
- 7.00 Driers shall be suitable for part load operation while maintaining the outlet air dew point as specified above. Necessary instruments and controls shall be provided to ensure that the specified dew point is maintained irrespective of input variations.
- 8.00 The contractor shall assume full responsibility in the operation of the air drying plant as a whole.

C. DESIGN AND CONSTRUCTION

1.00 Prefilters

1 x 100% Prefilter per ADP shall be located at the upstream of each drier.

- 1.01 Prefilters shall remove the bulk of moisture and any other contaminant including condensed oil which may be carried over from compressor in vapour form entrained in the air stream.
- 1.02 Prefilters shall be complete with Auto drain trap station, isolation and bypass valves, pressure indicators at inlet and outlet, relief valve etc.

- 1.03 The quality class of the filters shall be as per ISO 8573.1.
- 1.04 The filter vessel shall be as specified in other Clauses of this specification.
- 1.05 Automatic draining of prefilter/activated carbon filter for 30 seconds shall be incorporated by use of solenoid valve operating at an interval of about one hour in order to prevent condensed moisture entering into refrigerant dryer.
- 2.00 Pre-cooler, Evaporator and Refrigerant condenser
- 2.01 Pre-cooler, Evaporator and Refrigerant condenser shall be of shell and tube type construction.
- 2.02 Pre-cooler shall use dry air and wet air as shell and tube side fluids respectively.
- 2.03 Evaporator shall use refrigerant as shell side and air as tube side .
- 2.04 Refrigerant condenser shall be water cooled with refrigerant as shell side and cooling water as tube side fluid.
- 2.05 Design shall conform to TEMA (USA) – Class-C.
- 2.06 Heat Exchanger elements like shell, tube and tube sheet shall be adequately designed to withstand the design pressure.
- 2.07 Drain and vent nozzles and safety valves, as necessary, shall be provided for the pre-cooler, evaporator and refrigerant condenser.
- 3.00 Refrigerant Compressor
- 3.01 The compressor for the refrigerated type air dryer shall be hermetically sealed/semi sealed, reciprocating, medium speed, single acting type designed for R-134A/404A duty.
- 3.02 The reciprocating compressor shall be complete with cylinder liner, pistons, crank shaft, connecting rod, bearings, suction and discharge valves, crank case heater, proper lubrication system etc. (as applicable).
- 3.03 The compressor shall be complete with all parts and accessories recommended by the manufacturer to run it efficiently and satisfactorily.
- 3.04 The safety devices against high pressure of refrigerant, low pressure of refrigerant shall be provided.
- 3.05 The horse power for the compressor motor shall be sized for 120% of maximum rated power required for the unit including the drive loss.
- 3.06 The compressor assembly shall be adequately designed for minimum vibration and noise disturbances.
- 4.00 Expansion valve shall be of thermostatic type.
- 5.00 After-filters

After-filters specified in Data Specification Sheet shall prevent any carryover of fine particles with the effluent air stream. The numbers, type, design, materials of construction, accessories etc. of the afterfilters shall be same as that of prefilters, specified in clause 4.01.00.

6.00 Pressure Vessels

- 6.01 All pressure vessels such as moisture separator, prefilter and after-filter casings etc. shall be designed as per IS : 2825 or approved equal.
- 6.02 The vessels shall be of vertical self-supporting construction. All welding materials and procedures shall be as per clause no. : 4.10.00.
- 6.03 Each vessel shall be provided with suitable air-tight manhole and/or handhole and other connections as required.
- 6.04 Relief valves of adequate capacity shall be provided for each vessel. Relief valves shall be provided with hand lever. The valves shall be of stainless steel construction.
- 6.05 Internal surfaces of all the vessels shall be suitably protected against corrosion and rusting. Corrosion allowance of 2.5 mm shall also be provided on shell and dished end thickness.
- 6.06 Draining trap station complete with Auto drain trap, isolation and by-pass valves and Y-strainer shall be provided for pre-filter, air-receiver and moisture separator.

7.00 Mounting

All the components of the Air Drying Plant including the filters, interconnecting piping, valves, fittings, control panels etc. shall be mounted on a common fabricated steel base frame to form a self-contained unit.

Data Sheet of Instrument air compressors and air drying plant

Applicable codes	
BS:71(part-I & II)	ance test for positive displacement compressors and exhausters
IS:6206	for selection, installation and maintenance of air compressors, plants with operating pressure up to 10 bars
ASME PTC 9	acement compressors, vacuum pumps & Blowers
IS 5727	Glossary of terms relating to compressor and exhausters
IS:5456	Code of practice for testing of positive displacement type air compressors and exhausters
BS 726	Compressor performance test

ISO 1217	Displacement compressors-Acceptance tests
GENERAL CRITERION	
Type of Compressor	Screw Compressor
Duty	Continuous
Location	Indoor
Qty	1X100% capacity IA Compressors shall be provided for each unit with 1X100% common standby for all units and 1 X100% common maintenance stand by.
Design Ambient Temp.	50 Deg.C, 100% RH
Design Requirement	Instrument quality air as per specification at the required pressure and flow rate to meet the requirements of instruments, valves, actuators, bag filter cleaning etc. A 10% margin shall be provided on compressor capacity over and above the maximum flow requirement.
Drive	Electric Motor(Six(6) starts per hour)
Drive motor rating	The continuous motor rating (at 50°C) shall be at least ten per cent (10%) above the maximum load demand of the compressor in the entire operating range to take care of the system frequency variation. Total maximum load demand shall include air compression power plus any power consumed in auxiliaries like cooling fan etc. When the driver is not directly coupled to the compressor, due account shall be made for losses in power transmission in addition to the above 10% extra margin
Annunciation	Local/Remote as required
TESTING AND INSPECTION	
Hydrostatic Tests	Yes
Spot Radiography of Welds	Yes
Bend Test for receivers (as per BS-5169)	Yes
Performance tests at Full load; full discharge pressure; and full RPM as per	Yes

BS-1571, Part-2 or equivalent.	
Type test for motor	Yes

AIR DRYING PLANT		
A.	General Information	
	Installation	Indoor, Skid-mounted
	Duty	Continuous
	Quantity required	Three (3) [One with each IA Compressor]
	Type of Drying	Refrigerant type
	Refrigerent	R-134A/R-404A/ R-407C (Note Ferrom R22 is banned from Yr 2010 owibg to geen house effect on ozone layer)
	Service	Instrument Air
	Annunciation	Audio Visual
B.	Performance Specification	
	Capacity	Same as each IA compressor
	Inlet Air Pressure	To suit compressor rating
	Outlet dew point at 1 ata	(-) 20 Deg.C
	Maximum allowable air pressure drop	0.2 kg/sq.cm
	Quality of Instrument Air	
	- Dust Particle size	less than one (1) micron
	- Oil Content	100 % oil free
C.	Technical particulars	
	a) Pre-cooler	
	i) Type	Shell and tube type (Fixed tube bundle type).

	ii) Shell side fluid media	Dry Air
	iii) Tube side fluid media	Wet Air
	iv) Design pressure	Bidder to indicate
	v) Code of construction	TEMA-Class-C
	b) Evaporator	
	i) Type	Shell and tube type (Fixed tube bundle type).
	ii) Shell side fluid media	Refrigerant
	iii) Tube side fluid media	Air
	iv) Design pressure	Bidder to indicate
	v) Code of construction	TEMA-Class-C
	c) Refrigerant condenser	
	i) Type	Shell and tube type (Fixed tube bundle type).
	ii) Shell side fluid media	Refrigerant
	iii) Tube side fluid media	Clarified water
	iv) Design pressure	Bidder to indicate
	v) Code of construction	TEMA-Class-C
	d) Refrigerant Compressor	
	i) Type	Reciprocating

	ii) RPM	1500
	iii) No. of cylinders	Bidder to indicate
	iv) Type of coupling	Belt – Pulley
	v) Refrigerant	R-134A/ R-404A
	vi) Design standard	API-618
	vii) Testing standard	IS-5111
D.	MATERIALS OF CONSTRUCTION	
	Precooler, evaporator, refrigerant condenser	
	a) Tube	Stainless steel
	b) Shell	Seamless pipe or fabricated from steel plate (ASTM A-285 Gr.C)
	c) End plates	IS-2002 Gr.2A or equivalent.
	d) Tube sheet	IS-2002 Gr.2A or equivalent.
E	Air Receiver	
	a) General Information	
	Quantity	Bidder to indicate.
	Installation	Will be finalized after finalization of layout drawing. However indoor is preferred.
	Type	Vertical cylindrical with torispherical dished ends
	Design Pressure	8.8 Kg/Sq. cm (g)
	Hydraulic Test Pressure	16 Kg/Sq. cm (g)
	b) Capacity	Bidder to indicate

	c) Material of Construction	
	Shell	SA 515 Gr. 70
	End Plates (dished ends)	SA 515 Gr. 70 (Dished ends will be normalised)
	Flanges	SA 515 Gr. 70
	d) Supply of Accessories and Services	
	Companion flanges with nuts, bolts & gaskets etc.	Yes
	Pressure Indicator with snubber	Yes
	Pressure Switches	Yes
	Temperature Indicators	Yes
	Relief Valves	Yes
	Trap Stations	Yes
	Level Gauges	Yes
	Supporting stand with necessary foundation bolts, nuts, sleeves etc.	Yes
	Eye-bolts, lifting lugs, tools and tackles.	Yes
	Painting	
	i) External	Two coats of red-oxide primer and two final coats of synthetic enamel paints. Each coat shall be 50 micron thick. The total DFT shall not be less than 200 microns.

	ii) Internal	Shop painted as per manufacturer's standard
	e) Inspection and Testing	
	Material testing and identification	Yes
	Bend test as per BS-5169	Yes
	Hydraulic test	Yes
	Spot radiography of all circumferential & longitudinal Butt welds	Yes
	Field Performance test	Yes
	D.P. Test where Radiography can not be done	Yes
F.	SUPPLY OF ACCESSORIES AND SERVICES FOR EACH ADP	
	Strainer	2 x 100%
	Dew point indicator	Yes
	Instruments as per specification and as required for safe and trouble free operation	Yes
	Control panel with accessories	Yes
	Tools and tackle	Yes

	All interconnecting piping complete with fittings, valves etc	Yes
	Insulation	Yes
	Baseframe, foundation bolts, nuts, sleeves etc.	Yes
	Vessel internal surfaces	Anti-corrosive
	Shop painting	Yes
G.	INSPECTION AND TESTING	
	Non-destructive material test	Yes
	Performance tests at shop and site	Yes
	Spot Radiography of welds parts to be tested	All pressure parts and vessels
	Dye Penetration test	Yes
	Other specific tests as mentioned in Clause No. 6.00.00 of this section	Yes

5.26.00 Data Sheet

5.26.01 Pneumatic (pressurized) Ash Transport Pipe Lines & Fittings

Piping : Conveying from ESP/APH Hopper to Storage Silo
a) Manufacturer : To be decided by bidder

- b) Material and hardness : Specification and size of fly ash conveying pipe , should be designed for ash evacuation in minimum time and also should durable (at least 2 years life). Preferred SCH-80 pipe Proper care shall be taken to take care thermal expansion in ash conveying pipe line. Ash conveying line fittings material –Alloy CI/MS Basalt lined .

Velocity of air – ash
Mixture (M / Sec.)

- i) Pick up velocity : 14.0 m / s

- ii) Exit velocity : 15.0 m / s

- d) Quantity of each pipe length (M) : As per layout drawing

- e) Total pipe quantity (M) : As per layout drawing.

- f) Type of joints

- i) Pipe to Pipe : Sleeve Coupling
ii) Pipe to fitting / valve : Sleeve Coupling / Flanged
iii) Fitting to fitting / valve : Sleeve Coupling / Flanged

Fittings (Elbows, bends etc.) and spool piece

Conveying from ESP/ISH to Storage Silo

- a) Type of fittings & spool piece : Integral wear back
- b) Estimated number of various fittings & spool : As per layout drawing.
- c) Radius of fittings :
- d) Length of straight spool piece : -
- e) Material of construction, thickness and hardness of fittings, spool Piece and Lining, if applicable. : • Material - Alloy C.I. or cast basalt lined with 20mm thickness on minimum 6 mm MS pipe

- Hardness - 450 BHN
- Lining - As applicable

Inspection and Testing	
Pipes shall be tested hydraulically as per relevant standard.	
Fittings shall be tested hydraulically at twice the operating pressure or 1.5 times the design pressure whichever is higher.	
Note-For basalt line fittings a pipe spool 12D long having basalt lined at discharge end of bend/ elbow shall be provided. For impact bend a spool piece of alloy CI having 12D length with higher thickness shall be provided adjacent to fitting at discharge end. Here D represents pipe Nominal Bore(diameter).	

6.00.00 Parameters to be demonstrated for Ash handling System

Ash handling system performance guarantee (PG) test

Sl. No	Demonstration parameters for AHP	Data
1	Bottom Ash Handling system- Smooth operation of dry bottom ash handling system to convey & crush bottom ash, to Bottom ash steel silo under worst coal-BMCR condition with 24 Hour duration.	(System Guarantee for same is required from Bidder)
2	Ability to convey double conveying rate (ie 8 hour ash to be conveyed in 4 hour) by doubling the speed of conveyor	System Guarantee for same is required from Bidder)
3	Conveying of Economiser ash(8 hr ash generated under worst coal-BMCR condition) by 1 hour through pneumatic conveying system to BA silo	Conveying rate 32 TPH TPH
4	Conveying of APH hopper ash(8 hr ash generated under worst coal-BMCR condition) by 45 minutes through pneumatic conveying system to BA silo	Conveying rate 32 TPH TPH
5	Conveying of Duct hopper ash(8 hr ash generated under worst coal-BMCR condition) by 45 minutes through pneumatic conveying system to BA silo	Conveying rate 32 TPH TPH
6	Conveying of SRT hopper ash(8 hr ash generated under worst coal-BMCR condition) by 45 minutes through pneumatic conveying system to BA silo	Conveying rate 32 TPH TPH
7	Disposal of Bottom ash through telescopic chute provided beneath Bottom ash steel silo	@ 120TPH to close truck

8	Disposal of Bottom ash through rotary unloader & water spraying arrangement provided beneath Bottom ash steel silo	@ 120TPH to open truck
9	Smooth conveying of fly ash(without by passing any ash hopper) under worst coal-BMCR condition. Total fly ash generated in 8 hour shift(under worst coal-BMCR condition) will be conveyed within 5 hour including down time and change over time.	(System Guarantee for same is required from Bidder)
10	Continuous operation of compressors provided under full load condition during fly ash conveying(as mentioned above)	
11	Disposal of fly ash through rotary unloader & water spraying arrangement provided beneath fly ash silo. Testing shall be carried out for both fly ash silos	@ 180TPH to open truck for individual equipment / system
12	Disposal of fly ash through telescopic chute provided beneath fly ash silo. Testing shall be carried out for both fly ash silos 100% of system	@ 180TPH to close truck for individual equipment / system
13	Total guaranteed power consumption through energy meter during full load operation under worst coal-BMCR condition	
14	Silo vent filter exhaust air ppm	Within 30 mg/Nm ³
15	BA silo vent filter air PPM	Within 30 mg/Nm ³
16	Sound Level @ 1 m from various rotating equipment like compressors, Blowers	85 dBA

7.00.00 Bid Evaluation calculation and Performance Guarantee attracting liquidated damages:

SI No.	Description	Parameter for Performance Guarantee	Rate of liquidated damages	Applicability of bid evaluation / LD
1	Ash handling system Auxiliary Power	Under worst coal-BMCR condition, following equipment's are to be considered under running condition:-	Rate applicable for bid evaluation and LD shall be as per specification	Applicable for both bid evaluation & LD

	consumption	Dry bottom ash system shall be running for 8 Hour, Conveying compressors(working) & dryers shall be running for 8 hour, Fluidising blowers and heaters(as provided new by bidder) running for 8 hour. Total power consumption in Kw hr shall be calculated and shall be matched with quoted KW Hr of the bidder itself. If found exceeding than the quoted figure, then exceeded amount will be considered for LD . For Bid evaluation, least KWHr figure amongst the bidders shall be considered as base and others shall be measured with respect to same. Figure exceeding than base shall be added with the quoted price during bid evaluation		
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8.00.00 CONTROL SYSTEM AND OPERATION

8.01.00 Control Locations

Control provision for various systems shall be as follows.

Sl. No.	Sub System	Control System
1.	Bottom Ash and Coarse Ash Handling	The drives, valves & field instruments of Bottom Ash Hopper area & coarse ash hopper area is controlled by the Dry bottom ash PLC located in dry bottom ash control Room .

Sl. No.	Sub System	Control System
		However, necessary interfacing with CCR DCS/ AHP MCR PLC is also envisaged. These are included in scope of dry bottom ash handling package and the same is excluded from scope of Fly Ash package.
2.	Fly Ash Handling	The drives, valves & field instruments of ESP Fly Ash Handling Area is controlled by the AHP PLC (Hot Stand-by Configuration) located in AHP Main Control Room (AHP MCR). This AHP PLC will be placed in existing AHP control room
3.	Fly ash Silo area	From Silo area Utility panel (located in the Utility building adjacent to the Silo). The I/O from this area shall communicate with the AHP PLC in AHP main control room through RIO Unit. One number Silo Unloading panel with control switch and lamps is also there on fly ash Silo Unloading floor. The silo unloading operation will be done from this panel. It is envisaged that silo area utility panel is already existing and functioning
4.	Bottom ash Silo area	One bottom ash Silo Unloading panel with control switch and lamps is placed on bottom ash Silo Unloading floor. The silo unloading operation will be done from this panel in coordination with dry bottom ash PLC. These are included in scope of dry bottom ash handling package.

8.02.00 General

It shall be seen that substantial margin in design capacities and rates has been kept at each Ash Generating Points of the Boiler and its ancillaries.

In actual operation, however, all worst factors do not combine simultaneously. Therefore, considering usage of "design coal" producing "design ash quantity", considering actual Plant Load Factor of the units; it shall be seen that Ash Plant operation can be carried out without much problem.

Inevitable drop in performance of wear prone Ash Plant Equipment shall also be considered while selecting plant parameters and equipment.

The bottom Ash System design shall be such that it can handle the total quantity in dry mode considering worst coal.

The fly Ash System design shall be such that it can handle the total quantity in dry mode considering worst coal

- 8.03.00 Operation and Control Philosophy for BA and Fly Ash Handling System
- 8.03.01 The basic operation and control related to the bottom ash and fly ash extraction & removal system will be independent for each other and will be carried out in co-ordination from different local panels located near the system/equipment, either in automatic interlocked sequential mode or remote/ local de-interlocked manual mode as explained hereunder.
- 8.03.02 All instruments like pressure indicators, pressure switches, level control instruments, level indicators, level switches with alarm contacts, level control valves, flow indicators etc., as indicated in the enclosed single line flow diagram to facilitate effective control of the system, shall be furnished by the Bidder. Any other instruments not categorically shown in the flow diagram or mentioned in this specification but considered necessary for the safe & satisfactory operation of the system shall also be furnished by the Bidder.
- 8.03.03 All drive motors & motorised actuators & pneumatic valves will be controlled either from respective local panel or AHS main control room PLC with starting interlocks & permissive in remote mode as also from local start-stop station in de-interlocked local mode by means of "Local/Remote Selection" switch. The power circuit for the above will be in the MCC and HT/LT switchgear located in the switchgear room. Emergency lock out trip switch will be provided with all major drives with necessary interlock. All Air/Electric valves will be operated / controlled from respective control room. Local operation shall also be possible through manual override to be provided on locally mounted air line equipment (solenoid valve) for the actuators.
- 8.03.04 All prime movers shall have local start stop facility.
- 8.03.05 Generally, evacuation of FA system will be carried out sequentially/ Simultaneously. Evacuation of bottom ash and economizer hopper ash will be continuous one.
- 8.03.06 Broadly, the ash handling system operation/control scheme can be described as below:
There are mainly two zones of operation viz. 1) Bottom Ash Hopper area & coarse ash hopper area, 2) ESP Fly Ash Handling Area.

The drives, valves & field instruments of Bottom Ash Hopper area & coarse ash hopper area is controlled by the Dry bottom ash PLC located in dry bottom ash control Room .

The drives, valves & field instruments of ESP Fly Ash Handling Area are controlled by the AHP PLC (Hot Stand-by Configuration) located in AHS Main Control Room (MCR).

Various controls and interlocks shall be provided for the trouble free operation of the plant.

The various local junction boxes/local panels shall be located near the respective equipment in different areas. Common Systems, viz., Ash Water, Fly Ash Unloading system from collection point (like ESP, FF hoppers), Transport Air system & various Sump Draining systems etc are all controlled through AHP PLC.

Silo area Utility panel will be located in the Utility building adjacent to the Silo. This panel will also house control switches, lamps etc. for local operation. The I/O from this area shall communicate with the AHP PLC in AHS main control room through RIO Unit.

One Silo Unloading panel with control switch and lamps is also there on fly ash Silo Unloading floor. The silo unloading operation will be done from this panel.

One bottom ash Silo Unloading panel with control switch and lamps is also there on bottom ash Silo Unloading floor or at BA control room (whichever will be decided by client during detail engg stage).

Suitable alarm / annunciation system shall be provided to warn of any malfunctioning of the ash handling system.

8.03.07 Control Devices & Locations

The operation & monitoring of the ash handling system will be carried out from the following devices at indicated locations.

A. Main Control Room (MCR)

The AHS Main Control Room (MCR) houses the following devices:

- i) One (1) no. operator's work station and one (1) no. PC based engineering cum operator station with 21" TFT colour monitor; keyboard, mouse etc. shall be provided in the Ash handling system main control room for proposed unit

Two (2) nos. colour laser printer along with all accessories.

The AHP PLC located in AHS main control room shall control and monitor the operation of the complete ESP fly ash vacuum & pressure conveying system, water pumping system, slurry disposal system. This AHS PLC shall be provided with complete fly ash handling System graphics, electrical power supply network, indication, annunciation and all necessary interlocks.

The main AHP PLC will also have data communication facilities with DDCMIS in Central Control Room. Communication cable is to be laid between DDCMIS system and AHP PLC System.

One 2x100% hot stand-by UPS with 30 minutes battery back-up will be provided for powering various systems under AHP.

The Main Control Room shall be central control station for proposed Unit and shall have the basic indications for overall system operations from different sub-systems. The status of the following

shall be indicated at the Main Control Room PLC in AHP control room.

- a) Operation of Bottom Ash.
- b) Operation of Coarse Ash.
- c) Operation of Fly Ash.
- d) Number of conveying compressor operating.
- e) Silos under operation.
- f) Number of fluidizing blowers at ESP area and the fly ash silo area under operation.
- g) Electrical system.

B. Dry Bottom ash Control Room (DBCR)

The Dry Bottom ash Control Room (DBCR) houses the following devices:

- i) One (1) no. operator's work station and one (1) no. engineering cum operator station with 21" LCD/TFT colour monitor; keyboard, mouse etc. shall be provided in the Dry Bottom ash Control Room for proposed unit
- ii) One (1) no. A3 colour laser printer along with all accessories.
- iii) The dry bottom ash PLC located in Dry Bottom ash Control Room shall control and monitor the operation of the complete dry bottom ash handling system. This dry bottom ash PLC shall be provided with complete dry bottom ash handling System graphics, electrical power supply network, indication, annunciation and all necessary interlocks. Necessary number of I/O racks for the dry bottom ash PLC system shall be provided in dry bottom ash control room .
- iv) The main dry bottom ash PLC will also have data communication facilities with CCR DCS & AHP MCR PLC
- v) One 2x100% hot stand-by UPS with 30 minutes battery back-up will be provided to feed power supply to PLC-CPU & HMI-stations in dry bottom ash Control Room.
- vi) The status of the following shall be indicated at the dry bottom ash PLC located in dry bottom ash control room.
- vii) Bottom Ash Removal through extractor.
- viii) Operation of bottom ash hopper isolation gate (Or isolation gate cum jaw crusher)

- ix) Operation of first stage bottom ash conveyor and second stage bottom ash conveyor and their corresponding speed.
- x) Bottom ash temperature at the end of first stage bottom ash conveyor.
- xi) Temperature of ash at bottom ash silo
- xii) Operation of pre crusher/Primary crusher/secondary crusher.
- xiii) Ambient temperature and existing pressure at bottom ash hopper.
- xiv) Evacuation operation of Coarse Ash.
- xv) Mode of unloading operation from Bottom ash silo.
- xvi) Instrument Air pressure available.

As a typical example of the general nature of the controls, the functional requirements as well as the facilities for PC based operator's station located in Dry Bottom ash Control Room (DBCR) are furnished below. Similar detail functional requirements for all other control panels shall be furnished by the Bidder.

Functional Requirements

The following are some major functional requirements for the bottom ash local panel:

Maintaining of temperature at a particular demarcated zone on the first stage bottom ash conveyor.

Operation of crusher drive motors/ operation of gate cum jaw crusher/ operation of hopper isolation gate.

Determination of larger BA lumps and necessary synchronization to start operation of jaw crusher, pre-crusher and primary crusher.

Speed adjustment of various conveyors.

Operation of controlled disposal of CA to second stage bottom ash conveyor. Operator's work station located in Dry Bottom ash Control Room (DBCR) shall have, among others the following:

Feedback from Belt weigher fitted in the conveyor for measurement of conveying rate and subsequent belt speed control for controlling the material conveying rate.

Continuous monitoring of belt tension and drive torque.

Annunciation for chain / join snapping.

Safety features detecting first stage bottom ash conveyor and second stage bottom ash conveyor belt slacking and tensioning system to operate consequentially.

Proper (automatic) controlling for the openings of cooling air entrance, if any.

Start, stop and reverse motion arrangement with indication.

Safety feature detecting crusher jamming and auto reversal of crusher drive on occurrence of such jamming.

Auto/manual selection facility for reversal of crusher rotation in auto or manual mode.

Indication/annunciation for hydraulic system/power pack operation.

C. Fly ash Silo Utility Local Panel (FASULP) (existing)

Fly ash Silo area control panel will be erected in Fly ash silo area MCC room. This panel is also having control switches, lamps etc. One silo unloading panel with control switch and lamps is also there in silo unloading platform which will bring the inputs & outputs to silo area control panel. The silo area operation will be done from this panel however that can be monitored from AHP PLC in main AHS control room. The inputs & outputs and field instrument signals of silo area will be taken to AHP PLC through RIO Unit located in Silo Area MCC room / Utility building. This is excluded from Dry Bottom Ash Handling System Package.

D. Fly ash Silo Unloading Local Panel (FASUNLP) (existing)

One fly ash silo unloading local panel with control switch and lamps will be there on fly ash Silo unloading floor which brings the inputs & outputs to silo area control panel. The silo unloading operation will be done from this panel. This is excluded from Dry Bottom Ash Handling System Package.

E. Bottom ash Silo Unloading Local Panel (BASUNLP-1)

One bottom ash silo unloading local panel with control switch and lamps will be there on bottom ash Silo unloading floor which brings the inputs & outputs to PC based operator's station located in Dry Bottom ash Control Room (DBCR). The bottom ash silo unloading operation will be done from this panel.

F. Local Push Button Station (LPBS)

Local operation by-passing process interlocks of each drive / power actuator can be carried out by putting respective "TRIAL-NORMAL" selector on HMI in "TRIAL" position. In "NORMAL" position of the selector, the drive can be started from MMI, through respective PLC. Stopping of these motors can be affected through actuation of STOP switch at any control location irrespective of selection of "NORMAL" or "TRIAL" position. Local push button stations will be provided (ONE FOR EACH MOTOR) to facilitate de-interlocked field trial operation of the respective drives/equipment and will be located near each respective drives/equipment. Each of the push button station will incorporate one lockable "STOP" push button and located near respective equipment.

G. Manual Override of solenoid Valve

Local override operation knob to be provided on the solenoid valves.

8.04.00 Starting and running permissive for Silo Unloading By rotary ash conditioner

- a) The following starting and running permissive will be effective for operation of Paddle Feeder -
 - i) Water supply pressure to Paddle Feeder is NORMAL i.e. above a preset value sensed by a pressure switch.
 - ii) Instrument air pressure is at or above a preset value sensed by Pressure switch .
- b) The following opening and running permissive will be effective for operation of the Ash Feed Valve -
 - i) Paddle Feeder is RUNNING.
- c) The conditioning water to ash conditioner will be controlled by a manual globe valve provided in its water supply line.

8.05.00 Fly Ash System Operation (System Operation and Interlocks)

The fly ash system operation will be carried out for removal / onward conveying of fly ash from ESP hoppers of the unit. The fly ash cleaning operation will be carried out from the Main Control Panel (MCP) HMI, normally once in a shift of eight hours.

The entire fly ash cleaning operation is performed in two stages for dry disposal & one stage for wet disposal as described below.

8.05.01 Fly Ash Pressure System

- a) Under this stage of operation, designated as above, the fly ash received in respective hoppers are conveyed to the Fly Ash Silo for disposal by means of pneumatic pressure conveying process. During the cleaning operation, ash from the hopper is fed into the conveying line through cyclic operation of transport vessels / Air Lock Vessels provided below the hopper and is conveyed onwards with the help of compressed air supplied at the inlet end of the transport vessel.
- b) The operation of the Ash transport vessel gates will be of cyclic order having timer based sequence and /or actuation mode sequence
- c) **Full-Load Control**

During fly ash pressure conveying, if the conveying line pressure rises above the preset value sensed by a "FULL-LOAD" pressure set point of pressure transmitter, the bottom gates of all the Ash transport vessel on the operating ash conveyor (if open) will close immediately and remain closed until the line is cleared and the line pressure falls below the FULL LOAD PRESSURE set value, thus providing "FULL LOAD control" during the ash conveying.

8.05.02 Operation of Ash Transport Vessel

- a) The following starting / running permissive will be effective for cyclic operation of Ash Transport Vessel/Air Lock Vessels.
 - i) Instrument air supply pressure is "NORMAL".
 - ii) Fly Ash Silo ash level is below "HIGH".
 - iii) Silo vent – filter pulse jet cleaning sequence is "ON".
 - iv) Corresponding fly ash conveying path upto the silo is THROUGH.
 - v) Conveying air supply valves for the ash conveying lines are "OPEN".
 - vi) The conveying air compressor is in operation and conveying air header pressure is "NORMAL".

The failure of attaining any of the above permissive at any moment of system operation will stop the conveying operation. "FLY ASH PRESSURE SYSTEM TRIPPED" will be annunciated.

8.05.03 Operation Of Conveying Air Compressor

The Starting/ Running Permissive for REMOTE operation of the compressors is obtained through PLC by ensuring the following:

- i) The isolation valves on selected conveying path are open & "THROUGH".
- ii) Cooling water supply pressure for compressor is "NORMAL".
- iii) Cooling Water flow is adequate.

8.05.04 Operation of Ash Silo Vent Filter Pulse Jet System

The pulse jet sequence circuit of Ash Silo vent filter gets activated by actuation of "F.A. Pressure SYSTEM START" command from HMI or, "Silo Fluidising Air Blower START" command from Silo Unloading Panel . This will energise a local controller to carry out pulse jetting of the vent filter in an automatic timer based sequence.

8.05.05 Operation of Various Sump Drainage Pumps

- a) The following starting & running permissive will be effective for operation of the Drainage Pumps from local panel:
 - i) **Starting permissive**
 - Drain Sump level is at or above preset "LOW".
 - ii) **Running permissive**
 - Drain Sump level is above preset "DANGER LOW".
 - Respective Drainage pump seal water supply pressure becomes "NORMAL" within a preset time from pump starting.

8.05.06 **Fluidising Air System**

ESP Fluidising Air-Blower

Starting permissive :

Respective Blower is selected and its “START” command is given from HMI.

8.05.07 **ESP air blower heater**

- a) The following starting and running permissive will be effective during operation of heaters –

Starting permissive:

Any Fluidizing Blower is ‘ON’

Temperature is below ‘HIGH’ as sensed by corresponding instrument.

Running Permissive:

Temperature is below ‘HIGH’ as sensed by corresponding instrument.

8.05.08 **Silo Fluidising Air Blower**

Starting permissive:

Respective Blower is selected and its “START” command is given from Silo Utility Panel.

8.05.09 **Silo Fluidising Air-Heater**

- a) The following starting and running permissive will be effective during operation of heaters –

Starting permissive:

Any Fluidizing Blower is ‘ON’

Temperature is below ‘HIGH’ as sensed by corresponding instrument.

Running Permissive :

Temperature is below ‘HIGH’ as sensed by corresponding instrument.

8.05.10 **Operation Of Instrument Air Compressor (Owner’s scope)**

- a) Following starting / running permissive will be effective for operation of the air compressor :

i) Cooling water supply pressure for air compressor is “NORMAL”.

ii) Lubricating oil pressure “NORMAL”.

- b) The motor can be stopped by actuating STOP push button from HMI or, by STOP push button on Control Desk. Motor can also be stopped from its respective Local Push Button Station by actuating its 'Emergency Stop' Button. All interlock and logic functions for the package shall be performed through AHP PLC.

8.05.11 Ash Silo Unloading

Continuous silo level shall be shown by installation of level transmitter. Preferably, the silo fluidising should be started 30 minutes ahead of starting ash unloading from silo and be kept 'ON' so long as the unloading system is 'ON'.

8.05.12 Silo Unloading By rotary ash conditioner

- a) The following starting and running permissive will be effective for operation of Paddle Feeder -
 - i) Water supply pressure to Paddle Feeder is NORMAL i.e. above a preset value sensed by a pressure switch.
 - ii) Instrument air pressure is at or above a preset value sensed by Pressure switch.
- b) The following opening and running permissive will be effective for operation of the Ash Feed Valve -
 - i) Paddle Feeder is RUNNING.
- c) The conditioning water to ash conditioner will be controlled by a manual globe valve provided in its water supply line.

8.05.13 Operation of Dust Conditioner Water Pump

- a) Following starting & running permissive will be effective for operation of the Dust Conditioner Water Pumps.
 - i) Starting permissive
 - Silo Utility Sump level is at or above preset "LOW"
 - ii) Running Permissive
 - Silo Utility Sump level is above preset "DANGER LOW".

NOTE:-

- a) Pressure indicators, Flow indicators, Level indicators, Pressure Switches etc. as & where required for smooth functioning of the system shall be furnished by the bidder.

- b) All complete wiring & hardwares shall be provided by the bidder so that it can be readily connected to the purchaser's switchgear wherever required.
- c) Besides above so far described which is the min. requirement, the bidder shall include in his proposal a detailed & complete description of the Control System for safe, satisfactory & best operation of the plant complete with Schematic diagrams, description & function of component, rating etc.

9.00.00 LAYOUT & MAINTENANCE REQUIREMENT

- 9.01.00 All the dry fly ash pipes from ESP hoppers, will be routed to fly ash silo on pipe rack.
- 9.03.00 Access walkways/steps in the pump houses, control rooms, compressor house, silos etc., shall be provided and the dimension of the same shall be as per the civil technical specification volume-G1/G2 of this specification. Suitable galvanized hand railing shall be provided for personnel safety, wherever required. Suitable toe guard shall be provided at the landing platforms.
- 9.04.00 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.
- 9.05.00 All local panels, distribution boards, lighting panels, junction boxes, terminal boxes, marshalling boxes, push button stations, etc., shall be located in accessible locations permitting maintenance.
- 9.06.00 Minimum rear space for local panels and distribution boards shall be 1000mm from the nearest obstruction. Cabling shall be done clearing any interference between collars, greasing points and dust collection. There headroom below runoff cable trays shall be as per civil technical specification volume-G1/G2 of this specification.
- 9.07.00 All necessary platforms and access stairways for the operation and maintenance of equipment and valves shall be provided. Access/ maintenance platform shall be provided for cranes in compressor house, pump houses, silo utility room and walkway shall be provided for pipe racks. The dimension of the Access/ maintenance platform & walkway shall be as per civil technical specification volume-G1/G2 of this specification.
- 9.08.00 Rain protection hood with monorail shall be provided for each silo. 2T electric hoist shall be provided for each silo.
- 9.09.00 All cranes and hoists shall be confirming to Volume-II-I Section-II & Section - III respectively of "SUPPLY SCOPE BID DOCUMENT (Doc No. 24A11-SPC-G-001)", if not mentioned in this volume of specification
- 9.10.00 The system to design for zero liquid discharge, All excess liquid effluent reuse system to taken care by vendor during detail engineering.