

TECHNICAL SPECIFICATION	Job	Serie	KKS.	KEY.	Num.	Rev.	Page	Total
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Job:	BOCAMINA II - EPC Contract for a New Coal Power Plant
Title:	FLY ASH HANDLING SYSTEM - TECHNICAL SPECIFICATION

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1 INTRODUCTION

This specification covers the minimum requirements for supply of one flay ash handling system to be installed in the new 350 MW Coal Fired Power Station located in Bocamina II in Puerto Coronel (Chile).

The boiler will be coal fired, but distillate oil will be used during startup and sometimes in normal operation for both shut down and flame stabilization.

Steam generators will be equipped with low NOx burners, economizer, air heater and desulphurization system

The electrical power produced by the generating unit will be completely fed to the 220kV existing lines standing some km from the plant site

This document describes the supply of the fly ash system dedicated that will be integrally part of the plant. This is a 3-class supply; therefore Quality Control Plan is required to be issued by Vendor.

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2 LOCAL CONDITIONS, UTILITIES, CODES AND STANDARDS

2.1 LOCAL CONDITIONS & UTILITIES

For local conditions see the following document:

“Supply Specification – Fly ash handling ” – EAD000_G4_HDA_500_33P001

2.2 CODES AND STANDARDS

Wherever reference is made in the Technical Specification to specific standards and codes to be met by the equipment and materials to be furnished or tested, the provisions of the latest current edition or revision of the relevant standard and code shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure substantial equivalence to the standards and codes specified will have to be submitted.

The following standards and codes shall apply for all materials and mechanical equipment that will be supplied and used for the design, manufacturing, erection, commissioning and testing activities:

- ASME
- ASTM (for materials)
- AWS
- Chilean code for seismic design
- IEC
- ISA
- ISO (noise levels)
- Occupation Safety & Health Act - OSHA
- VDI
- API

In case of conflict or deviation between this chapter and every other attached document to the Material Requisition, the Bidder shall consult Maire.

2.3 FLY ASH HANDLING SYSTEM CHARACTERISTICS

2.3.1 General

Fly ashes conveying from :

- economizer
- air heater
- flue gas fabric filter

2.3.2 Material characteristics

The material characteristics to be considered are the following:

- aeratic bulk density 640 kg/m3

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- particle size range 175-20 micron
- moisture content 0%
- design temperature : economizer 380°C, air heater 125°C, flue gas fabric filter 125 °C

2.3.3 Fly ash flow

Total fly ash flow is 21 t/h from 3 different inlet point types

For the inlet points the following flow shall be considered:

- fabric filter; ash flow from 20 points (5 chambers x 4 lines)
 - 1° chamber & 4 lines 5000Kg/h (number inlet points: 4)
 - 2° chamber & 4 lines 4000Kg/h (number inlet points: 4)
 - 3° chamber & 4 lines 4000Kg/h (number inlet points: 4)
 - 4° chamber & 4 lines 4000Kg/h (number inlet points: 4)
 - 5° chamber & 4 lines 4000Kg/h (number inlet points: 4)
- air heater; ash flow from 2 points
ash 350kg/h (number inlet points: 2)
- economizer; ash flow from 2 points
500kg/h (number inlet points: 2)

2.3.4 Description of inlet points

Distance from inlet points at fly system to centerline of ash silo:

- fabric filter outlet points distance 75 m
- air heater outlet points distance 40 m
- economizer outlet points distance 60 m

Elevation at flange of discharge valve:

- fabric filter outlet points elevation 1.93 m
- air heater outlet points elevation 6.00 m
- economizer outlet points elevation 35.00 m

2.3.5 Type of conveyor

The bidder will be propose one of following systems by specifying the choice to be in accordance with the requested life and his own experience:

- vacuum type pneumatic conveying system
- pressure type pneumatic conveying system – dense phase
- pressure type pneumatic conveying system – dilute phase

2.3.6 Fly ash silo

The ash storage silo will be manufactured by carbon steel

The silo shall have a needed capacity to store the fly ash production of the boiler for 36 hours of operation at maximum continuous rating (MCR) without any discharge and having a free margin (the minimum total volumetric capacity to be considered is 1500 m3).

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The silo shall be equipped with adequate filters to permit the discharge of air introduced by fly ash conveyor and by fluidizing air with no dust emission exceeding the low limits admitted. The silo shall be equipped with 2 different ash discharge systems (dry system for discharge the ash on road tanker and wet system to discharge ash on normal lorry trunks by using humidifying mixer device).

Moreover the following equipments for ash storage silo will have to be include:

- silo steel structures, platforms, ladders, handrails, etc.
- stairs and platform at service level for maintenance and operation activities.
- Cabinets for electrical components and control system
- All other auxiliary equipments necessary to be complete the system
-

2.3.7 Fly ash handling system arrangement

The system shall be designed in order to maintain in operation the power plant.

The supplier must optimize the layout tacking in to consideration the above requirements.

The needed structures shall be included. Field conditions are indicated on attached drawing.

3 EXTENT AND LIMITS OF SUPPLY

3.1 SCOPE OF SUPPLY

The scope of supply shall include at least the equipment, services and materials detailed in the following paragraphs; items not mentioned hereinafter but necessary to ensure a correct and safe operation of the SYSTEM are intended to be part of the scope of supply unless expressly mentioned in chapter 4 "Exclusions"

The scope of supply shall include:

- Design / Technical engineering documentation
- Management
- Materials
- Manufacturing
- Testing & inspection
- Pre assembling
- Factory testing
- Painting
- Shipping Packing
- Storage and preservation (if necessary)
- Delivery F.O.B. (port to be agreed)
- Supervision to erection
- Supervision to Commissioning
- Attendance to Performance tests
- Personnel Training
- 24 months guarantee period
- O&M manuals (4 copies in Spanish language + 3 copies in English language)
- Final fabrication and test book of the factory tests

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3.1.1 General description of the inclusions in the supply

All necessary components necessary to complete the system including: Piping; Machinery; Equipments & device; Structures; Foundation bolts, complete with plates and in accordance with the following descriptions:

- *Detailed Engineering for steel structural, supports for piping, stairs, gratings, metal frames, gangways, and whatever else is necessary for the accessibility to the components that require maintenance and operation activities. Material supply separately quoted.*
- Materials, including consumables, which are necessary for start-up and commissioning phases.
- *Detailed Engineering for interconnecting loose piping that shall be installed between the components included in the supply. Material supply separately quoted.*
- Piping for process and auxiliary fluids within the composite components supply (like compressors & dryer skid, ash lancers, filters and other complex components).
- Special devices and equipment for assembling, dismantling and maintenance.
- Insulation to met the required noise level. The sound pressure level shall not be higher than indicated at paragraph noise of supply specification
- Hoists and monorails, for maintenance (if necessary).
- Cabinets necessary to locate electrical and I&C components (the control is PLC based).
- Fire protection systems (if necessary)
- All design, information and assistance required for shipment and transport to the job site and for conservation before the assembly/erection
- Executive and construction design of the service rooms including the related HVAC system, lighting system, fire protection system etc.. The building/s shall be located in silos area and/or service level.
- All design, information and assistance required for assembly/erection; for testing and supervision during assembly/erection; anticorrosive protections applying, paintings, thermal insulation applying, conservation of equipment, etc.
- All design, information and assistance required for the control and test of circuits, pre-operational, cold commissioning testing, functional and operational testing and start-up.
- Assistance in the foundation design to be carried out by MAIRE. Construction and detailed design drawings of foundation bolts and slabs, anchorage units, base frames, as well as special pieces and inserts in the building work for equipment installation.
- Training courses for the operating personel. The courses will have a total expected duration of 1 weeks.
- Operation & maintenance instruction books in Spanish language.
- Production and delivery of documentation. Documentation shall be produced using standard applications: WORD (written texts), EXCEL (data base) and AUTOCAD drawings).
- Components spare list needed for commissioning period and for five years of plant operation
- Functional and executive design of the supply.
- All the necessary data in order to put MAIRE in the condition of realizing the needed field works
- Equipment shop fabrication. Equipment shop paintings and coating.
- Shop testing and control.

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- Equipment tests certification.
- Pre-fabrication of structural, piping, etc. up to the maximum limit compatible with normal transports including the application of primer and first painting coat.
- Shipment preparation.
- Every needed authorization concerning the manufacturing and the supply of the equipments
- The limits of the supply of the metal structures are represented by the extrados of the foundations.

3.1.2 Electrical equipment

The scope of supply shall even include:

- All electrical device required by your project.
- Wiring and cabling including connections within the composite components supply (like compressors & dryer skid, ash lancers, filters and other complex components if necessary cabled in local junction boxes).
- *Detailed engineering for wiring and cabling that shall be installed in field. Material supply separately quoted.*
- The electrical battery limit is indicated in the document "Data Sheet – Fly ash Package Particular Characteristics" n° EAD000-F7-HD*-000-34B001.

The voltage levels, insulation levels and electrical characteristics, adopted by the BOCAMINA II power plant, are indicated in the documents EAD000-L2-VVT-000-34B001.

3.1.3 I&C equipment – General description & supply inclusions

I&C General description

Instrument & control system for safe and reliable operation, both in remote and in local mode. The fly ash handling system will be controlled by a dedicated PLC system, equipped with a local HMI interface installed in the cubicle front side door for operational purpose, which implements in an integrated manner the functions of control, supervision and protection of the unit to achieve a fully automatic functioning of the plant. The PLC system will be connected to the main control system (DCS, not in the scope of supply) through single connection via **Modbus RTU – 485RS** protocol in order to issue command (at least start/stop of the whole unit) and information concerning the status of each equipment of the unit with the central control room. Any other communication protocol shall be agreed with the Contractor. The serial link connection between fly ash handling automation system and plant control system (DCS) will be by fiber optic lines (not in the scope of supply).

Hardwire connections will be foreseen for safety related signals.

Besides control and supervision functions, the automation system shall support the configuration and diagnostic functions. The system diagnostics shall guarantee that all hardware malfunction shall be readily reported to the operator, to minimize the operation time

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under failure conditions and to get started by the application software the proper safety actions.

Technical requirements are detailed on Attachment 4 - 507E06-L3-CJA-000-34A001- PLC Technical Specification document. CPU and Power supply shall be redundant. PLC system manufacturer shall be in the submitted vendor list.

The conduction of the fly ash handling plant, both for fly ash transport and loading to/from the silo, will be performed by the dedicated HMI of the dedicated control system. Start-up and shutdown fully automatic sequences shall be provided. The sequences and devices commands shall be managed from the fly ash handling dedicated control system. Plant DCS HMI will be used only to allow supervision of the whole system from the central control room.

All tags description and alarms description and all the video pages shall be in Spanish language.

A database of the exchanged signals through serial link interface shall be made available according to criteria of maximum visibility of the structures up to the elementary level and functions. The supplier is asked to provide a sketch of the graphic displays to be implemented on the plant DCS system, equipped with the description strings necessary for the animation, in order to have complete information concerning the status of each machine of the fly ash handling plant.

All instruments, pneumatic or electronic, shall be fail safe on air and/or power failure.

All alarm and safety circuits shall be fail-safe; the relevant initiating contacts shall be closed during normal operation; solenoid valves and relays shall be energized during normal operation; action of valves in case of instrument air or electric power failure shall be such to lead the plant in safety condition.

The redundancy criteria for measurements shall guarantee the maximum reliability. The number of sensors shall be set as follows:

- single sensors for non-critical functions, such as supervision, diagnostic, optimization, non critical control, configuration;
- double sensors for critical functions, such as main process control, whose loss of control would cause a possible plant shutdown;
- triple sensors for safety functions (2oo3), such as protection functions and plant shutdown.

The three or two input signals devoted to the same process variable will be connected to different PLC input cards.

Refer to Attachment 5 - **EAD000-L3_CMA-000-34A001 - INSTRUMENTATION AND ACTAUTED/ CONTROL VALVE TECHNICAL SPECIFICATION** document.

The presence in the plant of high, middle and low voltage networks and of large electric loads produces both transient and permanent electromagnetic disturbances due to switching, motors start-up and short circuits.

Such disturbances shall not bring by errors or faults in the automation system of the fly ash management plant. In general electronic equipments of the whole system shall satisfy and be conform to the requirements of IEC standards and codes for industrial environments in terms of electromagnetic compatibility requirements.

The automation components (measure instruments, actuators, etc.) and generally all the automation equipment included in the supply shall be tested at presence of the Contractor. Refer to **EAD000-L3-CJA-000-34A001 – PLC Technical Specification** document for PLC system test procedure. The Supplier shall take an active part with the DCS Supplier for the integration of the system with DCS and will provide all the necessary equipment, human resources and services in order to allow the performing of the interface tests at the DCS vendor facility and in site for solving any problem that could arise during the tests.

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I&C supply inclusions

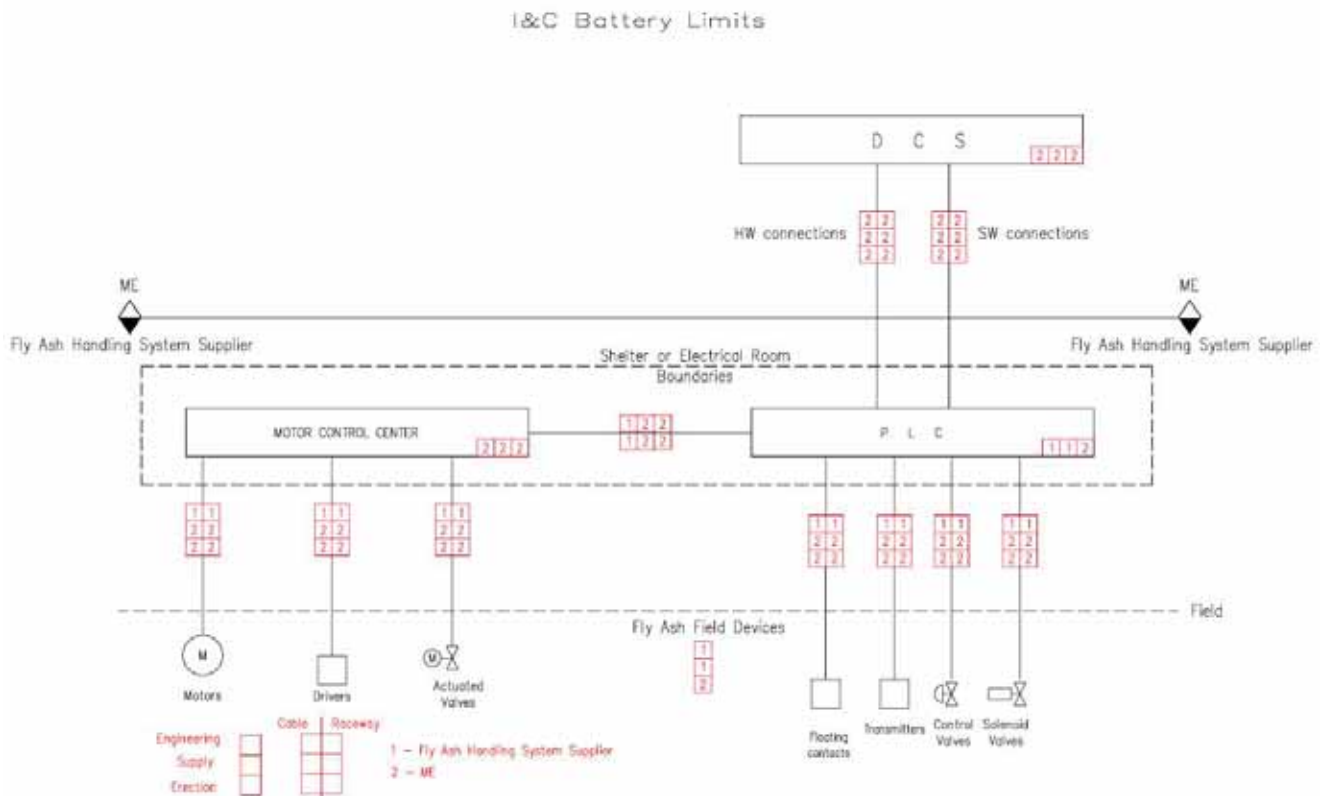
It is understood that the supply shall be complete and shall include everything that is required to activate the normal "automatic" functioning of the control systems and to ensure the "manual" operation of each equipment by the dedicated local HMI interface.

At least the following equipment shall be included in the scope of supply:

- Control System (PLC) with video rack mounted for the complete control and supervision of the fly ash handling system (both for transport up to silo loading and silo unloading).
- Local instrumentation (manometers, thermometers, etc.) on plant and machinery for local supervision.
- All supervision, management and control instrumentation: transmitters and switches (pressure, delta-p, level, flow rate, temperature, chemical analysis...) and related fittings, on plant and machinery for control and supervision of their regular functioning.
- Instrument primary process connections, electric and pneumatic secondary connections.
- The instrumentation is included with the supply with all the necessary fittings and calibration devices (where necessary) for the necessary measurement of the correct functioning of the whole unit.
- Automatic control valves.
- Pneumatic on-off valves and self-adjusting valves.
- Motorized on-off valves including electric actuator.
- Instrument racks, boards, junction boxes and enclosures.
- Junction boxes for analogue measurement signals.
- Junction boxes for digital signals.
- Various fittings.
- Engineering for cables and raceways between field equipments (instruments, valves, actuators, etc.) and PLC terminal boards.
- Instrumentation materials for assembly.
- Local control stations for fly ash silo unloading.
- Plant DCS interface: hardwired as necessary for safety functions; serial link connection based on RS485 - Modbus RTU protocol for remote supervision. Any other communication protocol shall be agreed with the Contractor.
- Scope of supply for electrical part is indicated in the "Data Sheet – Fly ash Package Particular Characteristics" n°EAD000-F7-HD*-000-34B001.
- Assistance to commissioning and start-up.
- Training activities for both operational and maintenance.
- Functional control description.
- Functional control diagrams
- Hardwired and soft-link I/O List (PLC-DCS)
- Control system Alarm & Setting list
- Instrument list
- Instrumentation erection typical drawings
- Instrumentation arrangement and lay-out
- Control & ON-OFF Valve List
- Instrument Data sheet (including Control and on-off valves)
- Wiring Diagrams
- Graphic displays Sketches for DCS
- The battery limits for the Control System shall be as follow:

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- Terminal strips of the PLC for hardwired connections to DCS.
- Communication card for serial link communication (Copper/Optical Media Converter interface included).



- Connections to plant grounding mesh
- Hopper bag filter with slide gate valve
- Hopper air heater with slide gate valve
- Hopper economizer with slide gate valve

4 EXCLUSIONS FROM THE SUPPLY

- Steel structural erection works, supports for piping, stairs, gratings, metal frames, gangways, and whatever else is necessary for the accessibility to the components that require maintenance and operation activities (only design and materials list is requested moreover is requested option for materials supply).
- Foundations and civil engineering works in general with the exception of those specifically indicated in chapter 3.
- Foundation bolts and slabs, anchorage units, base frames, as well as special pieces and inserts in the construction works for the installation of plant and machinery.

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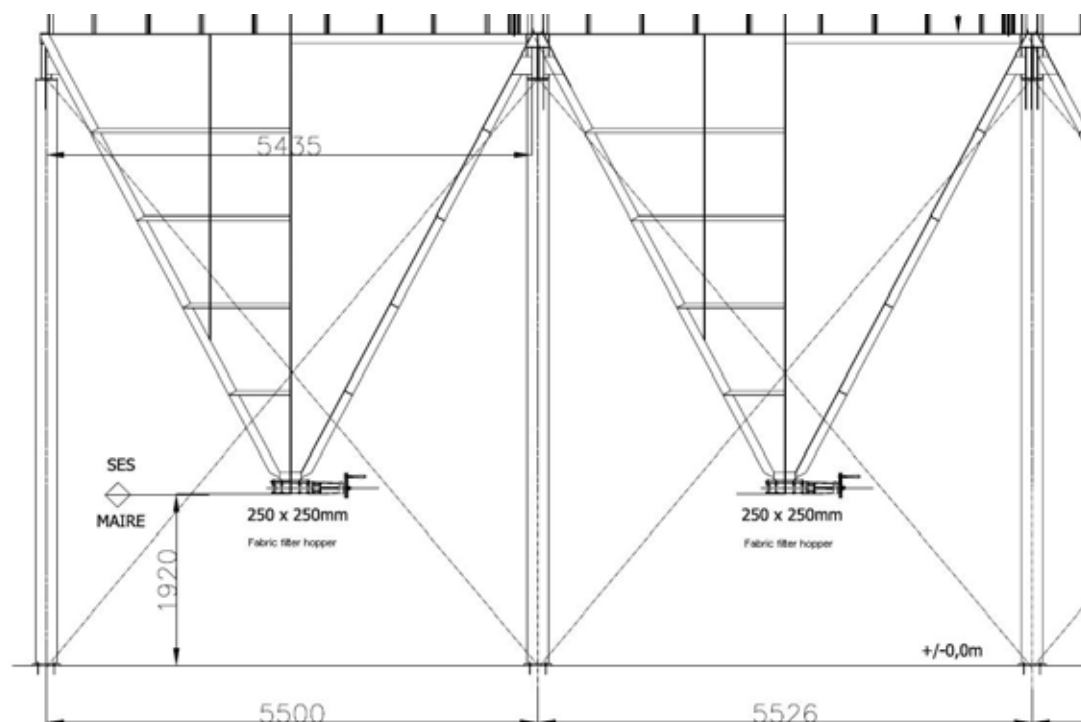
- Control cables and related cable ways between the interface terminal strip of PLC and Plant DCS or other external systems.
- Control cables between local J.B (only design and materials list is requested)
- Control cables between local Junction Bocks and between local control panel and DCS system. (only list is requested)
- Feeding electrical cables (all)
- Construction of the service rooms including the related HVAC system, lighting system, fire protection system etc.. The building/s shall be located in silos area and/or service level.

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5 FLY ASH DISCHARGE POINTS

5.1 FLUE GAS FABRIC FILTER FLY ASH DISCHARGE POINTS (Total 20 points)

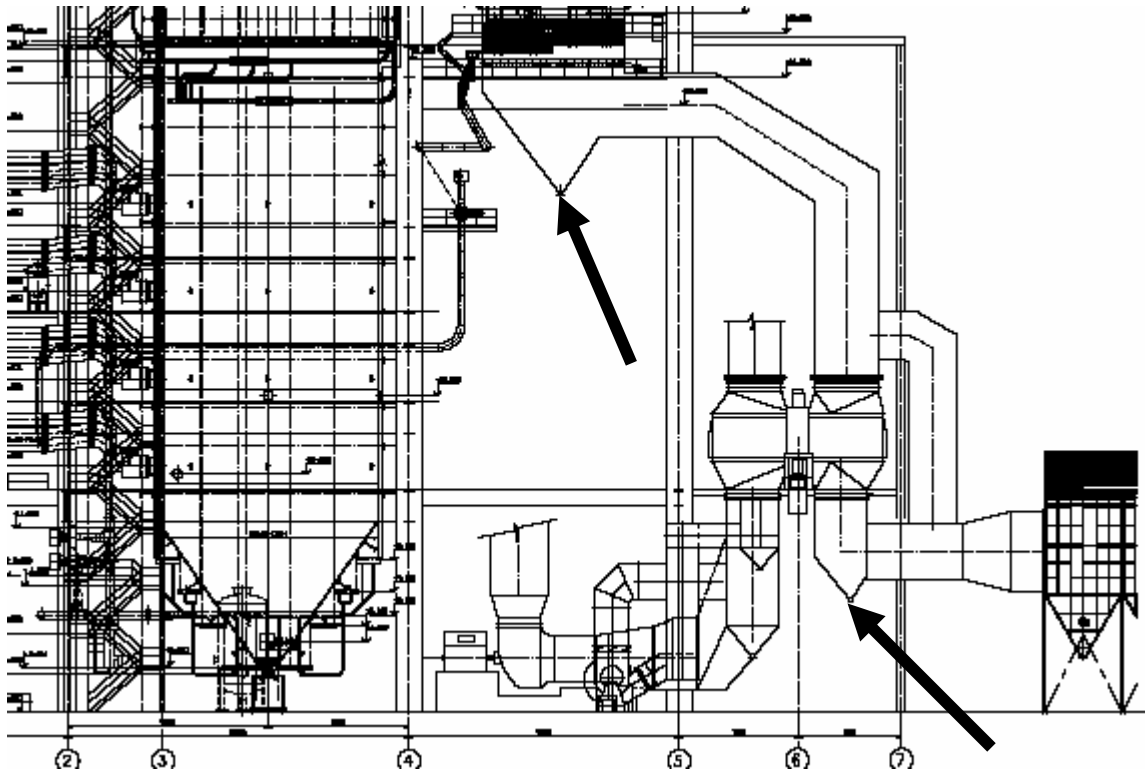
The inlet point at B.L. for Fly Ash Handling System shall be at valved discharge points like at those below indicated



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5.2 ECONOMIZER & AIR HEATER FLY ASH DISCHARGE POINTS (Total 4points hold)

The inlet point at B.L. for Fly Ash Handling System shall be at valved discharge points like at those below indicated



- air heater outlet points elevation 6.00 m
- economizer outlet points elevation 35.00 m

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6 TECHNICAL REQUIREMENTS

6.1 General design and operational requirements

The following main principles shall be taken into account as design basis, and all the materials, components or equipment shall be designed, manufactured and supplied with regard to the following:

- the power plant is located on the sea shore; materials and components shall be carefully selected in order to preserve the equipment life time, taking into account both the coastal climate and all the operating conditions, including the most severe ones. Appropriate provisions shall be implemented in order to protect the components during the construction and to allow for long term protection of the pumps during operation;
- The equipment shall conform to high standards of engineering design, workmanship and construction and shall be capable of operating efficiently, with high reliability and availability and without excessive wear or maintenance under all service conditions.
- safety of O&M personnel and of the equipment shall be considered as a major issue;
- conformity with the permissions, standards, codes and instructions applicable in Chile, e.g. IEC, ISO, EN, and HEI Standard is mandatory;
- design shall be in accordance with the state-of-the-art, and no prototype nor equipment design solutions recently introduced to the market and/or with poor reference list in power plant applications shall be used;
- brand-new, best quality materials and equipment, unused for any reason shall be supplied;
- appropriate design and construction features shall be implemented in order to prevent and avoid any type of corrosion and abrasion
- design solutions shall be implemented in order to minimize O&M costs.
- reliability during all operational conditions shall be of major concern.
- high material and workmanship quality shall be employed, in order to assure a smooth and trouble-free operation of system on an economic and environmentally compatible basis over the whole lifetime.
- protection of all components against subsequent damage in the event of any emergency shall be a fundamental consideration in the design of the system.

The approval of any document by Maire Engineering does not release the Vendor from the responsibility for any design mistake or omission.

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7 INSPECTIONS AND TESTS

7.1 Work Shop Tests

The equipments, components and materials shall be submitted to the tests foreseen by the Quality Plan approved by Maire Engineering as; where foreseen, shop tests shall be witnessed by Maire Engineering representatives. For each capital component the vendor shall list in offer the planned Factory tests

7.2 Site Tests

During the erection and commissioning activities the equipments shall be submitted to the tests foreseen by the Quality Plan approved by Maire Engineering and by the Commissioning Plan; site tests shall be witnessed by Maire Engineering representatives; Vendor's representative will also be allowed to witness site tests.

7.3 Performance Testing

After commissioning completion, performance testing will be performed.

The Performance Test shall be carried out in accordance to applicable standards and to the Vendor performance test technical specification that shall be approved by Maire Engineering. The Performance Test will be used to demonstrate that the system supplied meet the Performance Guarantees and to determine the amount of the applicable Liquidated Damages in accordance to the Contract.

The Vendor will provide a detailed Performance Test Specification providing a detailed description of the test

The Vendor will supply supervisors required to perform the test.

If during the Performance Testing, the System fails to meet the Performance guarantees of the Contract, the Vendor will notify Maire Engineering thereof, and take all actions necessary to remedy such failures in accordance with the contract.

Upon completion of the Performance Test, the Vendor shall submit to Maire Engineering a Performance Test Report summarizing the results of the test and a comparison of the results to the guaranteed values, providing details of test methods and procedures, and including complete supporting calculations, and copies of the uncorrected, corrected test data and instrument calibration records. Test report shall be sufficiently detailed to allow by part of Maire Engineering to ascertain if the Test have been successfully completed.

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8 GUARANTEES

8.1 Mechanical Guarantees

Characteristic of all equipment and component parts shall correspond and be guaranteed in compliance with requirements and codes defined in the purchase order documents.

Equipment and materials shall be free from manifest and hidden defects.

Life of all the components subjected to wear shall be guaranteed (wear rate shall be indicate for large radius bends/elbow) .

Any defects or malperformance, not related to improper operation, due to disregard of operating and maintenance manuals that occur during the guaranteed period, shall be eliminated by the Vendor as soon as possible.

The guarantee period shall be 24 months after the plant acceptance certificate.

The Guarantee must be revolving and sliding.

8.2 Performance Guarantees

The following performance parameters shall be guaranteed, according to the relevant values defined at point "FLY ASH HANDLING SYSTEM CHARACTERISTICS" and better specified in offer.

- Capacity at each charging point
- Power consumption
- Compliance to Environmental limits
- Max installed power
- Noise emissions

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9 DOCUMENTATION AND TRAINING

After the purchase order, the Vendor shall submit to Maire Engineering, for review and comments, a detailed Document List and Engineering Program in which all the documents pertaining engineering, fabrication, erection, quality control, commissioning, testing, training, operation and maintenance of the pump sets supplied will be listed with relevant delivery date.

The following is a preliminary list of documents to be included (as a minimum requirement) in the Vendor's Document List and corresponding requested delivery dates.

PRELIMINARY DOCUMENT LIST

DOCUMENT DESCRIPTION	DELIVERY DATE (AFTER PURCHASE ORDER)
General documents	
Document list and engineering program	15 days
Detailed schedule of supply activities	15 days
Subcontractor list/plan and program	15 days
Quality documents	
Quality plan	20 days
Quality Control Plans (in workshop and for site erection)	30 days
Test and inspections procedures (workshop)	30 days
Test and inspections procedures (at site)	60 days
Welding / fabrication procedures	20 days
Test reports, certifications	5 days after test or event
Welding book	20 days before shipment
Manufacturing Certification Manual	20 days before shipment
Mechanical and civil documents	
Assembly / equipment drawings	20 days
Inputs for civil works (static and dynamic loads on foundations, base and foundation plates, embedded parts, anchor bolts)	15 days
General arrangement drawings and related section of system	15 days
Components prospect & section drawings	30 days
Data Sheets of equipments	30 days
Auxiliary systems P&IDs & Process Specifications	30 days
Piping assembly drawings	45 days
Stress analysis reports if required	45 days
Piping support drawings	60 days
Equipment list, valve list, piping component list	60 days
Maximum weight and shape to be lifted during erection and maintenance	30 days
Electrical/I&C documents	
Instrument list	45 days

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DOCUMENT DESCRIPTION	DELIVERY DATE (AFTER PURCHASE ORDER)
I/O list (measures, alarms, trip etc.)	45 days
I&C functional specification (open loop, interlocking etc.)	45 days
Wiring diagrams	60 days
Electrical motor characteristic curves	30 days
J.B./instruments layout dwg	60 days
Miscellaneous	
Lubricant list/ Utility consumption list	45 days
Operating & Maintenance manuals	At shipment
Site erection/commissioning procedure and specification	20 days before shipment
Commissioning programme	20 days before shipment
Commissioning/first start-up procedure	20 days before shipment
Warehousing procedure	At shipment
Documentation for authorisations, accident prevention and other	30 days
Technical reports and calculations	30 days
Certifications and reports of statutory third party authority inspections (if any)	
Manufacturing Manuals	15 days before shipment
Operational procedures	At shipment
Operation manuals	At shipment
Maintenance manuals	At shipment
Equipment commissioning/test reports	15 days before ship.
Performance test procedure	15 days before ship.
Performance test report	10 days after perf. test

TECHNICAL SPECIFICATION	Job	Serie	KKS.	KEY.	Num.	Rev.	Page	Total
	EAD000	L5	HDA	000	33M001	00	21	21

10 INSTRUCTIONS TO BIDDERS

The offer shall include the documents listed below, in English language:

- System technical description
- Fully filled data sheets for equipments
- Technical comments and deviations to the specification
- Guaranteed Performances
- References regarding similar systems
- Mechanical outline drawing
- Main material packing list
- Foundation loads and foundation typical
- Quality assurance system description
- Test and inspection plan for workshop tests and tests at site
- Spare parts list for commissioning and start-up
- Spare parts list for 2 years and for 5 years operation
- List of special tools for erection and maintenance
- Sub-Vendor List