

	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Flue Gas Desulphurization Group-FGD, Boiler Auxiliary Plant (BAP), Ranipet
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TECHNICAL SPECIFICATION FOR MIST ELIMINATORS

SPECIFICATION NO : FGD:MISTEL:R00

BUYER (EPC) : BHEL, BAP Ranipet

APPLICATION : WET LIMESTONE FGD



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REV	Date	Description	Prepared	Checked	Approved

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DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

Sl. No.	Description	No of copies With proposal
1.	Documents for meeting the Qualification Requirement	1
2.	Reference plant list (as per Annexure-I)	1
3.	Compliance to Specification – Duly signed and stamped by the bidder	1
4.	Data Sheet for Mist Eliminator(as per Annexure-II)	1
5.	General arrangement and the cross-sectional drawing of the Mist Eliminator & its accessories.	1
6.	Schedule of Guarantee (as per Annexure-III)	1
7.	Deviation list (as per Annexure-IV)	
8.	Performance characteristic curves of Mist Eliminator	1
9.	Washing System data calculation sheet and Washing sequence	1
10.	Utility List & Required Pump Capacity	1
11.	Mandatory spares list.	1
12.	Start-up, Erection and commissioning spares list.	1
13.	Recommended Spares List for 3 Year's Normal Operation	1
14.	Proforma Packing List	1
15.	Approximate weight of each skid	1
16.	Support beam details and loading data	1
17.	Sub-Vendor List	1
18.	Scope of Supply	1
19.	Quality Plan	1
20.	List of Special Tools	1
21.	Delivery Schedule	1
22.	Droplet Measurement procedure	1
23.	WPS & PQR arrangement	1
24.	Man-holes, Viewing Ports, Sampling ports & Wash Pipe flange location & details	1
25.	Catalogue	1
26.	Terminal Point details	1
27.	Bill of Materials along with material and codes	1



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DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT:

Sl. No.	Description	No of copies After award of contract	Delivery Time
1.	General arrangement and the cross-sectional drawing of the Mist Eliminator & its accessories.	1	2 weeks after contract
2.	Isometric Drawing of the Mist Eliminator & it accessories	1	1 month after award
3.	Data Sheet for Mist Eliminator	1	2 weeks after contract
4.	Performance characteristic curves of Mist Eliminator	1	2 weeks after contract
5.	Washing system data calculation sheet , Washing sequence.	1	2 weeks after contract
6.	Utility List & Required Pump Capacity	1	2 weeks after contract
7.	Support beam drawing & loading data	2	2 weeks after contract
8.	Strength & performance Calculation	1	2 weeks after contract
9.	Mandatory spares list.	1	2 weeks after contract
10.	Erection and commissioning spares list.	1	2 weeks after contract
11.	Recommended Spares List for 3 Year's Normal Operation	1	2 weeks after contract
12.	Special tools list	1	2 months after contract
13.	Inspection and Test Procedure	1	1 month after contract
14.	Installation and assembly procedure	1	4 months after contract
15.	Inspection and Test Procedure	1	1 month after contract
16.	Quality Plan	4	1 month after contract
17.	Inspection & Test record	1	In 2 weeks after test
18.	Inspection Certificate	1	In 2 weeks after test
19.	Material Test Certificates	2	In 2 weeks after test
20.	Sub vendors List	1	2 weeks after contract
21.	Manufacturing Schedule	1	2 weeks after contract
22.	Progress report	1	Every month
23.	Proforma Packing List	1	2 months prior to shipping
24.	Approximate weight of each skid	1	2 months after contract



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Sl. No.	Description	No of copies After award of contract	Delivery Time
25.	Material Test Certificates	2	In 2 weeks after test
26.	Pre Commissioning Check List	2	4 months after contract
27.	Droplet Measurement procedure	2	1 month after contract
28.	WPS & PQR	2	2 weeks after contract
29.	Catalogue	2	2 weeks after contract
30.	Operation and Maintenance Manual Cleaning and repair procedure	• 10 hardcopies and 5 electronic copies in English	4 months after contract



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1.0 APPLICABLE CODES & REGULATIONS

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Mist Eliminator shall follow the latest applicable Indian/International (AISI / ASME/EN/Japanese) Standards.

2.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, supervision of erection & commissioning and performance testing of Mist Eliminators along with accessories which is to be furnished in the Flue Gas Desulphurization plant of Coal fired Power Plants. The following points may be noted.

- a. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
- b. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**Annexure-IV**)". In case of NIL deviation, bidder has to specify "NIL Deviation" in Annexure-IV.
- c. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- d. No deviation or exception shall be permitted without the written approval of the purchaser.
- e. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.
- f. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.
- g. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.



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3.0 PROVENNESS CRITERIA:

"Bidder should have previous experience of design, manufacture, supply, erection and commissioning / supervised erection & commissioning of the Mist Eliminators for Wet Limestone based FGD system for at least one (1) no. 500/ MW or higher capacity pulverized coal fired power plant such that respective equipment(s) should have been in successful operation for a period not less than One (1) year prior to Part-I (Techno-commercial) bid opening date"

The Bidder shall offer only proven design which meets the Provenness criteria indicated above. Necessary document evidences (PO copy/ GAD or Datasheet for the reference plant/Performance certificate from end user for the reference plant) for qualification shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their offer is liable for rejection.

4.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Supply, Testing and Supervision of Erection & Commissioning.

Design: Includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions commissioning procedures, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from END CUSTOMER.

The following items shall be Bidder's scope of design

- Performance Calculation
- Basic Design
- Detail Fabrication Drawings
- Support Beam Drawing and Loading data for Absorber Design
- Strength Calculation
- Documents for Fabrication, Inspection, Installation, Shipment and Erection & Maintenance works at site.

Supply: Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing.

Supervision of Erection, Testing & commissioning: Includes supervision of erection, Measurement of Outlet Mist concentration at site, training of customer's O&M Personnel and handing over to customer.

Supplier's scope shall cover complete Mist Eliminator unit including sub-systems, start-up spares and special tools (typically) as given below. The scope of supply for Mist Eliminators shall include but not limited to the following:



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Sl. No	Scope
1.	Mist Eliminator complete with - Mist Eliminator Panels complete for all the stages - Flushing system complete with all piping with flanges for front and back wash of each stage of Mist Eliminator - Secondary supports . - All the supports for Mist Eliminator Wash Pipe - All gaskets and fasteners required for fixing the Mist Eliminators and the wash pipes. - Painting and Rust Prevention during shipment and construction - Supervision of Erection & commissioning at site - Residual droplet content measurement at site using VDI Norm 3679. - Export packing and Inland Transportation - Special tools & tackles as applicable - Mandatory spares as per requirement - Start up Spares as applicable - Erection Spares as applicable. 3% of the Mist Eliminator panels, hardware and gaskets supplied shall be provided as erection spares. - Installation, operation and maintenance manuals - Any other items required for completeness of the equipment except the items covered in the exclusions.

4.1	DESIGN AND CONSTRUCTION FEATURES
a.	To separate the entrained droplets, mist eliminators are installed above the absorber spraying zone. Mist Eliminators offered shall be designed, installed, tested and operated so that high availability and high droplet removal efficiency is guaranteed.
b.	The residual droplet content shall be measured according to applicable clauses in VDI Norm 3679.
c.	Three stage chevron type Mist Eliminators (ME) shall be offered by the bidder which will be installed at the exit of Absorber. Material grade chosen by the bidder shall be field proven in previous installation for the corrosive and erosive condition prevailing inside FGD absorber.
d.	Provision shall be made for continuous washing of both ends of the first & second stage and the front section of the third stage of Mist Eliminators. Wash water arrangement shall also be provided at the back end of the Third stage of Mist Eliminators and it is meant for maintenance or during shutdown condition.
e.	The Mist Eliminator washing system shall be designed for cyclic washing of different



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	sections. Pneumatically operated valves required for cyclic washing will be provided by the buyer. Platforms for accessing the automatic valves for the spray system will be provided by BHEL.
f.	Entrained Slurry shall be collected by Mist Eliminators downstream of the slurry spray system to avoid carryover of slurry to the Stack.
g.	The ME system shall be equipped with washing and drain provisions, where drains are directed into the absorber. Washing provisions shall include external and internal piping systems with replaceable nozzles, complete with all piping.
h.	The Material of construction for the Mist Eliminator Wash Pipe header shall be as per Annexure. The material chosen by the bidder shall be proven and Mist Eliminator vendor shall have experience for the same
i.	Ease of replace-ability and placement of the mist eliminator on maintenance platforms is an important requirement.
j.	The ME shall be designed to allow for efficient cleaning in process
k.	Test ports will be provided by the buyer in the downstream of the mist eliminator to enable performance testing. Test ports location shall be recommended by the Mist Eliminator vendor.
l.	The mist eliminator system shall be capable of withstanding high velocity spray water jets typically employed during manual cleanings. The ME shall be constructed in individual cells. The design shall safely avoid ME vibration and/or humming. The individual cells shall be sized so that no more than two maintenance personnel are needed to handle them manually when they are fully scaled or plugged, and the cells shall be capable of passing through the access doors for the mist elimination section.
m.	Easy access for placement and replacement of the mist eliminator shall be incorporated in the design of the mist eliminator arrangement and the absorber vessel. Vendor shall provide recommendations for the same.
n.	Walkways will be provided by the Buyer. However, Size and location of Manholes which are required for installation and replacement of each segment of the Mist Eliminator shall be recommended by the Mist Eliminator vendor.
o.	The headroom shall have a height of more than 2200 mm.
p.	The mist eliminator support beams shall be designed to act as maintenance walkways approximately 300 mm wide and shall allow for a minimum 500 Kg/m ² load. The support beam/walkways shall provide personnel access to all mist eliminator modules, wash headers and wash nozzles. The support beam will be provided by the buyer.
q.	Adequate number of viewing ports with flushing devices connected to automatically operating washing system will be provided by the buyer at following locations: (i) Upstream of 1st stage (ii) Between 1st and 2nd stage (iii) Downstream of 2nd stage. (iv) Downstream of 3rd stage The regular flushing will be done in a defined time sequence. Viewing ports shall be



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	recommended by the ME vendor.
r.	Internal supports for mist eliminator sections, etc. shall be designed to withstand the flooded weight of the supported section.
s.	All internal piping support members for mist eliminator and flushing system shall be lined with minimum 2 mm Alloy 59/ C276.
t.	All the washing nozzles shall be made of Polypropylene/PVDF. The material used shall be field proven in previous installations.
u.	All metallic fasteners which are provided for the Mist Eliminator or Supports inside the absorber shall be of Alloy 59/ C276. Non-load bearing fasteners shall be as per vendor's standard practice.
v.	The Mist eliminators and its supporting structure shall be designed to carry sufficient load during maintenance.
w.	The formation of agglomeration, deposition & caking shall be avoided. For mist eliminators the bidder shall submit a cleaning procedure including the required safety measures as part of the inspection concept.
x.	Detailed washing procedure for the mist eliminator shall be submitted such as • Minimum washing water pressure (MPa) • Minimum Flow rate (m³/hr) • Washing time schedule and sequence • Nozzle type • No of spray nozzles • Size of header pipes • Valve list
y.	Mist Eliminator Panel's support shall be designed in consideration of dirty condition of the Mist Eliminator. Design Load of the Mist Eliminator shall be as follows, Mist Eliminator's weight including eliminated liquid weight plus max. allowable pressure drop of the mist eliminator.
z.	The thickness of the Mist Eliminator shall be as per vendor's proven practice. Vendor shall specify the thickness in their offer.
aa	The spacers to link each panel for restricting the gap between the panels shall be supplied.
bb	Blade surface shall be capable of supporting 225 kg of concentrated load, as might be experienced during inspection, while fully plugged with solids. Provide anchors, Fasteners, spacers and supports shall be provided by bidder to securely hold Mist Eliminator and prevent shifting during operation



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5.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit shall be used in the drawings and in the any displays on the equipments. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm ² G. For instance the pressure gauges should have dual units indication.
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English
3.	The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.
4.	Suitable drain connections shall be provided.
5.	The equipment shall be suitable for stable continuous operation.
6.	Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for utilities and branch piping to each nozzle. Terminal points for all utilities shall be located at Absorber wall edge at Mist Eliminator elevation. The bidder shall specify all terminal points with tie-in number in the P&ID and submit it in the proposal to confirm the scope of supply.
7.	Service life: Entire equipment except wearing parts shall be designed and fabricated for a minimum service life of 30 years of operation or 200,000 full load operating hours whichever is longer.
8.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable international standard.
9.	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150
10.	Name plate: Nameplate shall be provided indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase.
11.	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
12.	Equipment shall be fabricated as much as practical to minimize erection at the site.
13.	Washing headers support and its clamping arrangement along with fasteners shall be provided by the bidder.



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S.No	Description
14.	If the Mist eliminator is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
15.	Bidder shall provide the mating flanges with the necessary gaskets.
16.	All the surfaces of the carbon steel (if any) should be rust prevented before shipment for the period of at least 12 months for storage and construction.
17.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
18.	Quality Plan to be submitted along with the offer.
19.	During entire period of the project, the bidders shall strictly follow and adhere to the guidelines for effective Health & Safety Management. Supply of safety gears/PPE for bidder's/bidder's sub vendor personnel deputed at site for Supervision of E&C, etc. shall be in bidder's scope.
20.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
21.	Material of construction for all equipment/components shall be subject to BHEL/END CUSTOMER/END CUSTOMER's consultant approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.
22.	Bidder to provide sub vendor list and Bidder shall strictly adhere to BHEL/END CUSTOMER approved vendor list.
23.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the END CUSTOMER/END CUSTOMER's consultant and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications



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S.No	Description
	c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the customer/customer's consultant along with BHEL.
24.	Any shim plates for erection of equipment / item at site shall be in the scope of bidder.
25.	During detail engineering, bidder to strictly adhere to BHEL/END CUSTOMER/END CUSTOMER's consultant drawing formats, document numbering, quality plan & FQP formats
26.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).
27.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/END CUSTOMER/END CUSTOMER's consultant during detail engineering
28.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
29.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/END CUSTOMER/END CUSTOMER's consultant should be addressed timely by the bidder.
30.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.
31.	Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer. a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work".



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S.No	Description
6.0	PACKING AND FORWARDING
1.	Proper packing to be ensured. Indigenous Supply: The equipment shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the equipment during storage in the outer yard of power plant. Imported Supply: All imported supply (supplies from outside India) should be packed as per Sea worthy packing specification no. PE-TS-888-100-A001. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages
2.	Cardboard containers shall be enclosed in a solid wooden container
3.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
4.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
5.	Crates and packing material used for shipping will become the property of owner.(END CUSTOMER)
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: - Destination - Package Number - Gross and Net Weight - Dimensions



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S.No	Description
	e. Lifting places f. Handling marks and the following delivery marking
8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. BHEL SITE OFFICE, "ADDRESS OF THE PROJECT SITE AS PER ENQUIRY/ PO " INDIA In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care" , "Keep Dry" etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or



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S.No	Description
	varnish to prevent obliteration in transit.
15.	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Mist Eliminator & accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.
16.	Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
7.0	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING
	ERECTION
1.	The erection of Mist Eliminator and washing system will be done by buyer as per Erection Manual and check List provided by the bidder. However, the bidder shall make one visit per Mist Eliminator System for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.
2.	There will be one visit for each Mist Eliminator system. Total No of Visit shall be as per Enquiry/PO. The bidder will be informed well in advance for the visit. Bidder shall include 4 working days per visit in the offer.



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S.No	Description
3.	TA/DA, Travel expenses, boarding and lodging shall be borne by the bidder and shall be inclusive in supervision portion.
8.0	DROPLET MEASUREMENT/PERFORMANCE TESTING AT SITE
1.	Bidder has to measure residual droplet at Mist eliminator outlet for all the Mist Eliminators at site. The bidder will be informed well in advance for conducting the performance test (droplet measurement)
2.	Bidder has to complete the test for all the units as per enquiry/PO. TA/DA, travel expense, boarding and lodging shall be borne by the bidder and shall be included in the performance testing charges
9.0	EXCLUSION
	The following work associated with the Mist Eliminator will be by BHEL: a. Mist Eliminator Wash Pumps b. Piping from ME Wash pumps to Absorber wall at Mist eliminator elevation. c. Pneumatic operated valves d. ME Support beams
10.0	INSPECTION AND TESTING
	The General inspection requirements to be considered are as below:
1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings for review by BHEL/END CUSTOMER prior to manufacture. Inspection of above mentioned tests by BHEL representative at bidder's works is envisaged.
2.	The Bidder shall furnish performance test procedure along with measurement standard. The procedure will be reviewed and approved by the BHEL/END CUSTOMER.
3.	Final inspection and release by the BHEL/END CUSTOMER is a mandatory requirement unless specially waived.
4.	Acceptance tolerance of actual versus guaranteed performance for Droplet removal efficiency and Pressure drop shall be as per applicable standard.
5.	Mist Eliminator shall not be released for shipment, until shop tests data have been approved by Owner.
6.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.



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S.No	Description
7.	BHEL/END CUSTOMER shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
8.	Bidder to arrange all calibrated gauges, Instruments during inspection.
9.	Bidder to arrange Instruments and all accessories for the measurement at site as per applicable clauses VDI Norm 3679.
10.	The performance test & droplet measurement may be carried out at site for Guarantee conditions and shall be converted to the design condition.
11.0	SPARES,TOOLS & TACKLES
11.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Mist Eliminator & sub system. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. The following startup/erection & commissioning spares shall be supplied by bidder along with main supply free of cost: All hardware's and gasket – 3% In addition to the above, any other spares required for Start-up and commissioning deemed necessary by the bidder shall be supplied. The spares must be available at site before the equipments are energized.
11.2	RECOMMENDED SPARES
	Bidders shall also furnish the Recommended spares list along with the offer required for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment.
11.3	MANDATORY SPARES:
	Bidder to quote for the mandatory spares as per enquiry/PO. Bidder shall quote for the "Mandatory spares", and it will be considered for L1 evaluation. Initial spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall not be dispatched before dispatch of corresponding main equipments. The mandatory spares shall be clearly identifiable and suitable tagging shall be made by the bidder. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Initial spares shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan.



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S.No	Description
11.4	SPECIAL TOOLS & TACKLES:
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.
12.0	PERFORMANCE GUARANTEE
	All performance tests for Mist Eliminators shall be carried out in accordance with any latest international codes/standards. 1) The mist eliminator outlet droplet content shall be guaranteed to be ≤ 20 mg/Nm³ at 6% O₂ dry at absorber outlet measured over a period of 24 hrs continuous operation. 2) Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer. 3) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Mist Eliminator and its accessories 4) Maximum Pressure drop across M/E at Design Point condition i.e. 20 mm H₂O (G) is to be guaranteed. It shall be measured at Guarantee point conditions in site and shall be converted to the design condition. 5) The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year 6) In the event that the performance test is unsuccessful in meeting performance guarantees, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.
13.0	WARRANTY:
1.	The Bidder shall warrant that the equipments/items shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed. The Warranty period shall be 24 months from the date of supply or 18 months from the date of commissioning, whichever first occurs. If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Bidder, the Bidder shall promptly, in consultation and agreement with BHEL regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Bidder shall, at its discretion,



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S.No	Description
	determine) such defect as well as any damage to the Facilities caused by such defect.
2.	In case of failure of the equipment to meet the guarantee, END CUSTOMER/BHEL reserves the right to reject the equipment. However, END CUSTOMER/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
14.0	TRAINING
	Successful bidder shall provide comprehensive training for END CUSTOMER/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the ME system - Operation & Maintenance, Troubleshooting, cleaning procedure etc.
15.0	CONFLICT
	Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising End customer in writing of any conflicts between the specifications and Bidder's design, including performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.
16.0	DOCUMENTATION
	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	List of Drawings or documents to be submitted after award of contract is enlisted. Drawings that are reviewed by the END CUSTOMER/ BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a "hold" on those items or areas of design. END CUSTOMER/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by END CUSTOMER must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDS shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. Unless agreed otherwise, Ten (10) hard copies and five (05) sets of electronic copies of



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S.No	Description
	all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per END CUSTOMER requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However all the engineering related information shall be furnished in soft form to BHEL.



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18.0 ANNEXURES

ANNEXURE – I

a) REFERENCE LIST as per format shown below. (at least One (1) reference plant details)

S. No.	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD Yes/No	Model	Flue gas flow Nm ³ /hr	Size	Outlet Mist Concentration mg/Nm ³	Year of Commg	Qty

NOTE: Performance certificate (End user feedback) or Unpriced PO or contract copy is required for 1 No Reference plant meeting the qualification requirement

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



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ANNEXURE – II- TECHNICAL DATA SHEET

Enquiry No: _____

Project: _____

Sl. No	Description	Data
1.0	GENERAL	
	a. Buyer	: BHEL-Ranipet
	b. Project	:
	c. End Customer	:
	d. Location	:
	e. Service	: Continuous
	f. Installation	: In-door
	g. Total number of Mist Eliminators and Accessories (No of sets)	: -Bidder to Provide-
2.0	MANUFACTURER DETAILS	
	a. Model	: -Bidder to Provide-
	b. Type	: -Bidder to Provide-
	c. No of stages	: -Bidder to Provide-
	d. Vane type for Coarse , Fine , Superfine separators	: -Bidder to Provide-
	e. Pitch details for Coarse & Fine separators	: -Bidder to Provide-
	f. Weight data	: -Bidder to Provide-
	g. Flushing system details	: -Bidder to Provide-
	(i) Nozzle Details :	
	Type of Nozzle	
	Spray angle	
	Size	
	Thread	
	Flow rate	
	Nominal size	
	(ii) No of nozzles for 1st stage upstream	
	(iii) No of nozzles for 1st stage downstream	
	(iv) No of nozzles for 2nd stage upstream	
	(v) No of nozzles for 2nd stage Downstream	
	(vi) No of nozzles for rd stage upstream	
	(vii) No of nozzles for 3 rd d stage Downstream	



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3.0	OPERATING CONDITION	:	"As per Technical Information of Mist Eliminator specific to the Project"
4.0	PERFORMANCE DATA		
	a. Face Velocity	m/s	: Bidder to Provide
	b. Pressure Drop	hPa(G)	: Bidder to Provide
	c. Limit Drop Size	Micron	: Bidder to Provide
	d. Temperature resistance of ME System	Deg C	: "As per specification"
	e. Performance curves (i) Pressure Drop Vs Gas Velocity (ii) Outlet Mist Load vs Gas Velocity (iii) Limit Drop Size vs Gas Velocity (iv) Collection Efficiency vs Drop Size		: Bidder to Provide
	f. Washing sequence & Valve List		: Bidder shall submit the sequence with detailed write up
	g. Utility list & required Pump Capacity		: Bidder to Provide
5.0	MATERIALS		
	a. ME Panel		: Bidder to Provide
	b. Washing Pipe		: Bidder to Provide
	c. Wash Pipe Supports		: Bidder to Provide
	d. Washing Nozzles		: Bidder to Provide
	e. Hardwares		: Bidder to Provide

7.0 WASHING ARRANGEMENT

7.1	Washing water condition	
a.	Flow rate - Average	Bidder to provide
b.	Flow rate – Instantaneous Allowable Max	"Shall Not exceed tender specification"
c.	Feed Pressure (at inlet flange of ME Wash header)	"As per tender specification"
d.	Spray pipe level from ME Panel	< 700 mm



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7.2 Washing Method							
		First Stage		Second Stage		Third Stage	
		Front Surface	Back Surface	Front Surface	Back Surface	Front Surface	Back Surface
a.	Total Washing Area m ²						
b.	No of divided sections						
c.	Washing Water Source						
d.	Washing Water Average Flow rate m ³ /h	*	*	*	*	*	*
e.	Instantaneous Max Water Flow rate m ³ /h	*	*	*	*	*	*
f.	Duration of One washing for One Divided Section Sec	*	*	*	*	*	*
g.	Time of One washing Cycle (min)	*	*	*	*	*	*
* Bidder to fill the value Note. 3 rd stage back surface washing - only for Maintenance							

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



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ANNEXURE III- SCHEDULE OF GUARANTEES

Enquiry No: _____

Project: _____

Sl. No	Description	Data
1.	Mist eliminator outlet droplet content mg/Nm ³ at absorber outlet measured over a period of 24 hrs continuous operation.	: ≤ 20 mg/Nm ³ at 6% O ₂ dry
2.	Total Pressure drop across M/E at mmwc(G) design point condition	: < 20 mm WC
3.	Equipment Availability (%)	
	Equipment Availability for 120 days %	: Bidder to Provide
	Equipment Availability for 1 year %	: Bidder to Provide

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



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ANNEXURE – IV- LIST OF DEVIATIONS/EXCEPTIONS TO THE ENQUIRY DOCUMENT

Enquiry No: _____

Project: _____

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items. In case of NIL deviation, bidder has to specify "NIL Deviation".

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

00	13-03-2020	Fresh Release	<i>S. Shanmuga Sundaram S</i> Shanmuga Sundaram S	<i>V Kesavan</i> V Kesavan
REV	DATE	DESCRIPTION	Prepared	Checked & Approved

1.0 TECHNICAL INFORMATION

Sl. No.	Description	Requirement
1.	End Customer	NTPC Limited
2.	Project Name	Patratu Super Thermal Power Station Expansion Phase-I 3x800 MW
3.	Location	Patratu, Ramgarh District, Jharkhand
4.	Type	Three stage chevron type (All the three stages Roof type Or First Stage with Flat and 2 nd , 3 rd stage Roof type)
5.	Quantity	
i.	Quantity of Mist Eliminators for Unit-1,2,3	3 sets (1 set for each unit) 1 set means Complete Mist Eliminators, Washing systems and accessories.
6.	MOC	
i.	ME Panel	Polysulfone
ii.	Washing Pipe	CSRL or FRP or PP or PVC
iii.	Wash Pipe Supports	Alloy 59/C276
iv.	Washing Nozzles	PVDF or PP as per bidder's proven practice
v.	Hardwares inside absorber	Alloy 59/ C276 for load bearing applications
7.	Parameters	
i.	Gas flow	Vertical
ii.	Casing Dimension	Length : 9900 mm Width : 31900 mm
iii.	Design Pressure of Mist Eliminator Panel	660 mmH ₂ O (G)
iv.	Max Allowable Pressure drop across Mist Eliminator element	20 mmH ₂ O (G) at Design point
v.	Design Temperature	• 70 Deg C (Continuous) • 80 – 90 Deg C (30 minutes) • 90 – 100 Deg C (5 min)
8.	Gas condition at ME Inlet	Guarantee Point Design Point
i.	Gas Flow Rate (Nm ³ /s-wet)	943 1034
ii.	Gas Flow Rate (m ³ /s-wet)	1143 1261

Sl. No.	Description	Requirement	
iii.	Gas Temperature (Deg C)	58.1	62.1
iv.	Density (kg/m ³)	1.03149	1.00296
v.	Operating Pressure at Mist Eliminator inlet (mm H ₂ O (G))	47	60
vi.	Gas Flow Distribution	+ or - 20%	
9.	Gas Composition at ME Inlet		
i.	SO ₂ (Vol%-wet)	0.0021	0.0023
ii.	H ₂ O (Vol%-wet)	17.80	21.45
iii.	O ₂ (Vol%-wet)	5.91	5.65
iv.	CO ₂ (Vol%-wet)	9.67	9.25
v.	N ₂ (Vol%-wet)	66.61	63.66
vi.	HCl (ppm-wet)	<3	<3
10.	HF (ppm-wet)	<1	<1
i.	Dust (mg/Nm ³ -wet)	<50	<200
11.	Entrained Mist Condition:		
i.	Mist Concentration at Inlet –at Guarantee & Design Point	200 g/Nm ³ -dry	
ii.	Mist Concentration at Outlet –at Guarantee & Design Point	≤20 mg/Nm ³	
12.	Mist Composition		
i.	Solid	25 wt.%	
ii.	Cl ⁻	21950 ppm	
iii.	Mg ²⁺	4330 ppm	
iv.	Ca ²⁺	5790 ppm	
v.	Na ⁺	240 ppm	
vi.	SO ₄ ²⁻	1450 ppm	

1.1 WASHING ARRANGEMENT

i.	Washing water condition	
a.	Flow rate - Average	40 m ³ /hr *1)
b.	Flow rate at M/E Inlet – Instantaneous Allowable Max	120 m ³ /hr
c.	Flow rate at M/E Inlet – Instantaneous Min	100 m ³ /hr
d.	Feed Pressure (at inlet flange of ME Wash header)	0.2 MPa (Max)

II.	Washing Method	First Stage		Second Stage		Third Stage	
		Front Surface	Back Surface	Front Surface	Back Surface	Front Surface	Back Surface
a.	Total Washing Area m ²	9.9 x 31.9	9.9 x 31.9	9.9 x 31.9	9.9 x 31.9	9.9 x 31.9	9.9 x 31.9
b.	Washing Water Source	Refer Clause 5.2					
c.	Washing Water Average Flow rate m ³ /h	*	*	*	*	*	**
d.	Instantaneous Max Water Flow rate m ³ /h	*	*	*	*	*	**
e.	Duration of One washing for One Divided Section Sec	*	*	*	*	*	**
f.	Time of One washing Cycle (min)	*	*	*	*	*	**
		* Washing method shall be confirmed by the vendor. ** Only for Maintenance *1) shall be finalized by vendor					

1.2 WATER ANALYSIS

Process water is envisaged for Mist Eliminator washing. Process water analysis is provided below.

S.no	Constituents	Unit	PROCESS WATER
1.	Calcium as CaCO ₃	ppm	105
2.	Magnesium as CaCO ₃	ppm	81
3.	Sodium as CaCO ₃	ppm	70
4.	Potassium as CaCO ₃	ppm	7
5.	Iron as fe	ppm	0.5
6.	Total alkalinity as CaCO ₃	ppm	180
7.	Chlorides as CaCO ₃	ppm	60
8.	Sulphate as CaCO ₃	ppm	23
9.	Silica	ppm	17
10.	pH	-	7.0-7.8
11.	Turbidity	NTU	10

1.3 MIST ELIMINATOR ARRANGMENT AND MIST PARTICLE SIZE DISTRIBUTION:

- a) BHEL will provide only two level of Mist Eliminator Support beams separated by 2.6 m distance. Bidder shall offer either
- (i) Roof Type Design for all the stages (or)
 - (ii) Flat Type for 1st stage and Roof Type for 2nd, 3rd stage
- b) Bidder to decide the spray washing arrangement.

The Mist Particle Size Distribution shall be as per below fig:

Fig. 2 Mist Particle Size Distribution(EXPECTED VALUE)

