MeeFog TECHNICAL APPLICATION NOTE AN-GT-204

Mee Industries Inc.
GAS TURBINE DIVISION
204 West Pomona Ave. • Monrovia, CA 91016-4526
tel. 800-732-5364, 626-359-4550 • fax 626-359-4660 www.meefog.com

Typical Specification for Gas Turbine Inlet Fogging System

AN-GT- 204

APPLICATION NOTE: AN-GT-204

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BACKGROUND

Being the world leader in the manufacture and implementation of over 422 gas turbine fogging systems, MEE INDUSTRIES is often asked to assist potential users in defining and specifying guidelines for inlet fogging systems.

This Application Note provides a sample specification has been prepared to meet this need. It is intended to be a guideline for end users and will have to be modified to meet project specifics as appropriate.

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1.0 SCOPE

1.1 Introduction

This technical performance specification provides the site requirements and the limits for design, structural analysis, fabrication and delivery to site of one (1) fog cooling system to be installed in an existing air intake filter system.

It allows the supplier to use their own expertise in design, choice of materials and construction of the air intake system components within the limits described.

1.2 System Description

The fogging will be installed in an existing air intake system. An outline drawing of the air intake system is enclosed as part of this specification. The supplier shall investigate possible positions of the fogging equipment and give recommendations for the best location.

All cooling water pumps, valves etc. and the electrical control panel shall be installed on a separate skid located at floor level. All equipment on the skid shall be suitable for outdoor application.

1.3 Definitions

The following definitions shall apply to this specification:

User Employees of the user or its designated representative.

Supplier Company to which inquiry or order is awarded.

1.4 Applicable Documents

The documents listed herein and the enclosed table of contents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect at the time of the order shall apply.

a) Nothing in this document, however, supercedes applicable laws and regulations unless a specific exemption has been obtained.

b) User shall be notified immediately by writing if a conflict between this document and laws, regulations or other documents cited herein occurs.

1.5 Proprietary documents

All documents and drawings furnished by user shall be treated as proprietary information and shall not be used for other than their original purpose without written permission from the user.

Similarly all documentation provided by the supplier will be treated as proprietary information and only used for bid evaluation purposes.

1.6 Supplier's offer

1.6.1 The supplier is required to offer as specified. Any deviation of this specification and its attachments must be mentioned in a deviation list and the corresponding cost impact shown in the price breakdown for each deviation separately.

1.6.2 The documents to be submitted with this offer are shown in section 4.

1.6.3 In addition to the supplier's proposal, the fill-in sheets of Appendix B shall be filled out. Missing or non-complete sheets may result in rejection of supplier's proposal.

1.6.4 The supplier shall submit an electrical load plan with the quotation.

1.7 **Supplier's Qualifications**

1.7.1 The supplier must have proven experience of supplying inlet air cooling on a range of heavy duty gas turbines that have inlet fogging. Media type evaporative cooler experience will not be considered. At least 5 years of experience with gas turbine inlet fogging is a must.

1.7.2 Experience must be on gas turbine systems utilizing inlet fogging both for peaking & base load operation (i.e. fogging used throughout the year)

1.7.3 Supplier must provide a detailed user list indicating specifics of gas turbines, date of installation and other details.

1.7.4 The supplier must have ISO 9001 certification.

1.7.5 The supplier must demonstrate expertise with gas turbine engineering, and have personnel that have gas turbine background .

1.7.6 Supplier must provide at least 5 letters of recommendation from past users of its fogging systems.

1.7.7 Supplier should state if it has the capability and experience to model the inlet duct and fog flow by means of CFD techniques, if this is required.

1.8 Scope of Supply

The scope of supply includes all necessary activities and items to meet the intent of this specification to achieve highest availability and economic operation.

The scope of supply includes design, construction, manufacturing, quality assurance, schedule, follow-up, detailed assembly description of all components and documentation. Scope includes:

1.8.1 Fogging system complete with all nozzles, piping and fastening devices.

1.8.2 Pump skid with all necessary pumps, valves, water filters, piping, drain equipment and interconnection cabling.

1.8.3 On the water supply interface and on the drain interface, two flanges include bolts and gaskets shall be supplied.

1.8.4 Complete piping between fogging nozzles and pump skid. Supplier to estimate distance.

1.8.5 One (1) main local control panel located at fog skid level with all necessary controls and instruments to assure reliable operation of the system.

1.8.6 Fog nozzle manifold located in gas turbine gas turbine inlet duct including all supports and hardware needed.

1.8.7 Detailed description of the control system for the water supply at different ambient conditions.

1.8.8 Supplier’s documentation: erection and commissioning documentation, operation documentation, maintenance documentation, parts catalogue and quality documentation.

1.8.9 Commissioning spares as needed.

1.8.10 Provision of supervisor for installation & commissioning the fog system.

1.8.10 Training for Operation and Maintenance of the fogging system for at minimum a 4 hour duration.

1.9 Fog Intercooling (overspray) capability

Supplier to clearly state what overspraying (fog cooling) capability exists, how it can be adjusted and how it can be utilized.

1.10 Limit of Supply

Supplier's scope must include the following:

1.10.1 Inlet connection points for electric supply at terminal board in skid control panel consisting of one power cable only.

1.10.2 Outlet connection points for alarm and control signal at terminal board in skid control panel.

1.10.3 Water supply pipe interface and drain supply pipe interface at the pump skid.

Scope by Others:

1.10.4 Concrete pad for skid installation will be supplied by the user.

1.10.5 Sunshade/roof over skid will be supplied by the user.

1.10.6 Instrument cable /wiring (interconnecting cables) from the fog skid to the buyer's control system will be supplied by the user.

1.10.7 Supply of Demin water to the skid edge at the sellers defined inlet conditions of pressure and temperature and quality.

2.0 DESIGN AND DESIGN FEATURES

2.1 Codes, Standards, Rules and Regulations

2.1.1 General

a) All equipment shall be designed in accordance with applicable industry codes, standards, and regulations.
The most stringent requirements shall apply where addressed by more than one code, standard or regulation.

b) The latest edition at purchase order date, with related revisions and addenda of the following regulations shall apply.

c) The design, equipment and materials forming part of the contract shall comply in all respects with applicable laws and applicable permits currently in force in the destination country.

d) This following list of codes, standards and regulations is not complete and does not relieve the supplier from complying with any other requirements and regulations applicable to this equipment. These codes and standards shall apply if no others are prescribed in the project specific specifications.

2.1.2 Hardware and Workmanship Related Standards

a) Codes, standards rules and regulations of organizations covering the respective portion of equipment and work.

b) Publications and regulations of all authorities having jurisdiction and as specified in this document.

2.1.2 Steelwork

a) American Institute of Steel Construction (AISC)
b) American Welding Society (AWS)
c) American National Standards Institute (ANSI)
d) American Society for Testing and Materials (ASTM)
e) American Society of Mechanical Engineers (ASME)

2.1.4 Electrical Equipment

a) International Electrical Code (IEC)
b) National Electrical Code (NEC)
c) Institute for Electronic Engineers (IEEE)
d) Underwriters Laboratories (UL)

2.2 Units

2.2.1 Metric units shall be used on all drawings, specifications, descriptions, etc., including erection manual, operation manual, and maintenance manual and parts catalogue. Dual units (Metric and United States Customary Units (USCU) is permitted.

2.2.2 The use of [mbar] and [bar] instead of [Pa] is allowed for fluid and gas pressure.

2.3 Design Data

2.3.1 Number of units to be retrofitted with Fog Cooling & Design data- Please see Appendix A

Appendix A provides the following information pertaining to this request for quote:

- Gas Turbine data and performance.
- Site conditions/Climate conditions and design point in terms of the wet bulb depression.
- Details of the gas turbine intake filter house and duct work up to the compressor inlet.

2.3.2 Environment
The supplier shall take into account the environment at the plant location (air, water, temperature, location, elevation, climate, pollution, etc.) by selecting appropriate systems, components, materials, coatings, etc.

2.4 General Requirements

2.4.1 The fog cooling system shall be pre-assembled in order to minimize assembly at project site.

2.4.2 The fogging nozzles, piping and fastenings shall be designed in a way, that no pieces can fall apart under any operating conditions. The design of the fastening systems must be described in the proposal.

2.4.3 A viewing window should be installed downstream of the fogging system. Optional viewing window at bell mouth may be suggested.

2.4.4 Gaskets, specified by the supplier, shall avoid air leakage and satisfy acoustic / vibration requirements (e.g. excessive transmission of high frequent vibration/noise due to incorrect selection of gaskets is not permissible.)

2.4.5 Pumps and control panel shall be designed as a skid, which will be placed beneath or near the filter house at floor level (level 0.0 m.)

2.4.6 The interconnecting piping between manifold array and pump skid shall be 316L stainless steel.

2.4.7 In case fogging system and air intake housing material are different, galvanic isolation (“inserts”) between shall be used on all connecting points.

2.4.8 The system and its non-consumable components shall be designed for a service life of twenty five (25)years.

2.4.9 The final electrical loads shall not exceed the values given in the preliminary load plan.

2.4.10 Applied materials, special design ideas, etc. shall be specified in the tender.

2.4.11 Gauges and instrumentation shall have both metric and U.S.C.U. units.

2.4.12 The design shall consider ease of maintenance.

2.4.13 All fasteners, bolts, nuts, washers and screws shall be stainless steel (at least 304L quality).

2.4.14 Structures and critical structure elements shall be reinforced sufficiently to meet the design parameters (e.g. with steel members).

2.4.15 The assembly drawings and descriptions shall be sufficiently detailed and clear to allow a proper assembly. If weather protection of the fog skid is recommended, this will be suggested by the supplier and installed by the buyer.

2.5 FOG NOZZLES & FOG NOZZLE MANIFOLDS

2.5.1 Fog Nozzles shall be impaction-pin type with a type 316 stainless steel body with 1/8" nominal pipe thread. Orifice shall be not more that 0.006-inch diameter, to ensure adequate distribution of fog injection points.

2.5.2 Nozzle shall generate droplets of less than 6 microns, measured as Sauter Mean Diameter, (SMD32) at a point 3 inches (7.5 cm) in front of the nozzle orifice center, at an operating pressure of 2000 psi (144 kgf/cm2) and with an air stream velocity of 3000 ft/minute (910 meters/minute. Nozzles shall have a replaceable 40-micron particle size, fused-plastic-bead filter.

2.5.3 Fog Nozzles shall be provided with a tie-wire hole and shall be wired to the Fog Nozzle Manifolds with a stainless steel tie-wire.

2.5.4 Fog Nozzle Manifolds shall be stainless steel tube, type 316, ASTM A249 tube, 1/2" OD with 0.035-inch wall minimum thickness.

2.5.5 All Fog Nozzle Manifold fittings shall be double ferrule-type compression fittings, constructed of type 316 stainless steel.

2.5.6 Fog Nozzle Adapters shall be permanently attached to the stainless steel Fog Nozzle Manifold tube and shall have an o-ring water seal for the Fog Nozzles.

2.6 High Pressure Feedlines

2.6.1 All high-pressure feedlines shall be ASTM A249, type 316 stainless steel tube with a rated operating pressure of not less than 10,000 psi.

2.6.2 The 1/2-inch OD feedlines shall have a wall thickness of not less than 0.035-inches. 3/4-inch OD feedlines shall have a wall thickness of not less than 0.049-inches.

2.6.3 All fittings for high-pressure feedlines shall be double-ferrule type compression fittings constructed of type 316 stainless steel.

2.7 WEATHER STATION

2.7.1 Supplier shall provide a weather station complete with temperature and humidity sensor and radiation shield installed so that it senses ambient weather conditions.

2.7.2 Supplier shall provide all interconnecting cables between Weather Station and the Pump Skid Controller.

2.8 PUMP SKID CONTROLLER

2.8.1 Provide a Programmable Logic Controller (PLC) complete with an Operator Interface Terminal (OIT) with a display screen and keypad. The PLC shall be installed on the Pump Skid in a NEMA 4 rated box with a door that can be easily opened without the use of tools.

2.8.2 The PLC shall have all software required for operation of the pump skid devices, monitoring of pump skid safety devices and interlocks. Operation principles must be supplied with proposal.

2.8.3 The PLC shall have all software required for computation of ambient wet bulb temperature based on data received from the Weather Station.

2.8.4 The PLC shall have all software required for control of the fog cooling stages based such that the operator can control the degree of over saturation or under saturation in the inlet air duct.

2.8.5 The PLC shall have an (Ethernet, RS232, etc.) port on the PLC for communication with host computer and shall compute:

- The current ambient relative humidity and dry bulb and wet bulb temperatures.

- The number of fog cooling stages currently in operation current system output, in degrees (specify °F or °C) of cooling and in gpm (or liters per minute, etc.).

-The current percentage of the wet bulb depression (difference between wet bulb and dry bulb) that is currently being utilized by the fog cooling system.

- Any fault/alarm conditions and what they are (or specify one “global” fault signal).

2.9 PUMP SKID INTERLOCK DEVICES AND PLC SOFTWARE

Supplier shall provide:

(1) Water flow meter measuring total skid water flow through the skid and PLC software to alert the operator if water flow falls to 80% of the baseline value—indicating nozzles are plugged.

(2) An inlet pressure switch for each pump unit (on/off) and PLC software to shutdown the affected pump and alert the operator if pressure fails to come up to setpoint—indicating a problem with the supply water.

(3) A discharge pressure switch for each pump unit (on/off) and PLC software to shutdown the affected pump and alert the operator if pressure fails to come up to setpoint—indicating a problem with the pump or with the high pressure lines.

(4) An auxiliary contact for the magnetic contactor for each pump (on/off) and PLC software to alert the operator if the contactor fails to open when the pump is called—indicating a thermal overload condition.

2.10 FOG PUMP UNITS

2.10.1 High-pressure fog pump units shall be ceramic plunger type with all wetted parts being stainless steel, ceramic or Buna rubber. Pumps shall be operated at not more than 700 rpm at full flow and rated for not less than 2000 psi maximum operating pressure.

2.10.2 Back pressure regulating valves shall be type 316 stainless steel, rated for operation at 2000 psi and fully adjustable.

2.10.3 High and low pressure gauges shall be liquid-filled type with stainless steel construction. Low pressure gauge from 0-60 psi, high pressure gauge from 0-3000 psi.

2.10.4 Pump and motor base and belt drive guard shall be epoxy painted steel mounted to the skid plate with rubber feet.

2.10.5 Drive motors shall be totally enclosed and fan cooled.

2.10.6 Pump must be capable of operating at minimum system flow without overheating of pump head.

2.10.7 A flexible hose with Teflon core and braided stainless steel jacked shall be used to connect the pump to the discharge feed line.

2.11 FOG PUMP SKID

2.11.1 Skid shall be constructed of 1/4" steal plate welded to steal box-tube frame. Grounding lug and lifting lugs shall be provided.

2.11.2 Skid shall be sandblasted prior to painting, undercoated, then top coated with epoxy paint.

2.11.3 A high capacity inlet water filter with sub-micron filters shall be provided.

2.11.4 Stainless steel solenoid valves for the inlet of each pump unit shall be provided.

2.11.5 All interconnecting piping and fittings shall be type 304L stainless steel or better.

2.12 Water Quality

The water supplied to the skids (by user) will be demineralized to a level of 5 ppm TS (Total Solids) (TSS + TDS) or less and filtered to 10 microns. The water pH shall be maintained above 6.5 to ensure long fog nozzle life. Fog system manufacturer shall ensure that all wetted components are suitable for use with such water. Water supplied by the user will be to the on-line wash specifications of the gas turbine OEM.

2.13 Electrical Requirements

********* (User to Select as appropriate) **********

2.13.1 Electrical Supply (50 Hz or 60 Hz)
The supplier is responsible to provide isolation transformers for all lower voltages, which are needed by his system but not available.

Electric supply 50Hz

Phase	3
Conductor	3PH+PE+N
Voltage	400+10% VAC -15%
Frequency	60+5% Hz -6%

One (1) Phase 230+10%/ -15% VAC power supply for light and plugs in the filter house shall be taken out of the three (3) phase power supply.

Electric supply 60Hz

Phase	3
Conductor	3 PH +PE
Voltage	480+10% VAC -15%
Frequency	60+5% Hz -6%

2.13.2 Electrical Components

a) All electrical components shall be completely pre-wired in each module via local junction boxes.
b) Control and junction boxes shall be mounted directly on the fogging skid.
c) The supplier shall provide all needed cables (within the skid).
d) The interconnection between junction boxes and user's DCS/Control will be wired by others on site.

2.13.3 Security

a) Only automatic circuit breakers are acceptable.
b) The location of the grounding (earthing) plate shall be clearly visible on the layout drawings.

2.13.4 Electric Motors

All electric motors will be TEFC designs, with Class F insulation.

2.14 Instrumentation and Controls

2.14.1 Local Control Panels

a) All switches, measuring and indicating devices shall be installed in the local control panel.

b) Inspection is performed via inspection windows and panel mounted components, therefore control panel and inspection windows shall be located at a convenient position above the floor line.

c) If outdoor conditions apply, additional protection against rainfall and solar radiation will be provided by the user.

d) All control panels will be tested and fully functional.

2.14.2 Contacts

a) All ALARM contacts shall be hermetically sealed (reed contacts) or snap action switches (micro switches).

2.15 Corrosion Protection

2.15.1 Painting & Coating

1) To protect and to prevent any part of the system from corrosion, appropriate measures shall be taken. Supplier to provide details of their paint system.

2) Touch-up paint shall be supplied for touch-up on site after installation.

3) Galvanized material (zinc, zinc containing products) is not allowable in the air intake after the filter system. Exception: Prime coat in a three (3) coat protection.

2.15.2 Components Design

a) All bolts, nuts, washers, screws and other fasteners shall be stainless steel (at least ANSI 304 L quality). Where corrosion between fasteners and ground material would occur (e.g. stainless steel and carbon steel) additional plastic “inserts” shall be used.

b) All supports, stiffeners, bracing ribs etc. shall be designed to trap no water.

c) To prevent water and moisture accumulation, drip water shall be drained (e.g. low point drains in the filter house). In order to avoid unfiltered air entering through the drains, an appropriate sealing device (e.g.) check valve shall be supplied.

d) Where contact or galvanic corrosion can occur, as example between the following materials aluminum,carbon steel and stainless steel, plastic inserts shall be used.

2.15.3 Panels and Boxes

a) Corrosion protection of local control panels and junction boxes shall be sufficient for outdoor installation.

3.0 SUPPLIER PROVIDED DOCUMENTATION

(1) Product Data: Catalog sheets indicating general assembly, dimensions, weights and material of construction.

(2) Drawings: Provide general assembly, dimensions, weights and material of construction. Provide Piping and Instrumentation drawings, electrical schematics, ladder diagrams, etc.

(3) Supplier to provide schedule of drawings that will be provided after receipt of order.

4.0 SUBMITTALS REQUIRED WITH PROPOSAL

Supplier should supply the following with the proposal:

(1) General arrangement drawings and typical Electrical and Installation drawings.

(2) Provide PLC software documentation and operators guide (typical).

(3) Provide project reports for similar projects completed including general specification of equipment installed and operator-feedback.

(4), Provide a copy of manufacturer’s Quality Assurance Manual and procedures.

(5) Provide proof of certification to ISO 9001 for gas turbine inlet fog cooling system design and manufacture.

(6) Provide a computational analysis of the Manifold Array to ensure no resonant frequency conditions exist due to flow induced vibrations.

(7) Provide a written power increase guarantee in Megawatts at the fog cooling system design condition.

(8) Provide a complete turnkey project schedule from initial design to installation and test.

(9) Provide test data of fog cooling nozzles showing droplet size distribution with Sauter Mean Diameter (SMD32) of less than 5.5 microns measured at 3" in front of nozzle, at 3000 ft/min.

(10) Provide Duct Evaporation Curves for the Application. This should show the transient variation of time, humidity and temperature.

(11) Provide details of Bidders R&D activities and capabilities relating to Gas turbine inlet fogging.

(12) Describe what CFD capabilities exist to optimize fog flow in the intake duct.

(13) Supplier should clearly state if fog nozzles utilized are manufactured by others or are manufactured by the supplier itself.

(14) Supplier shall provide a tabulation clearly showing pump design showing pump rating point and operating point (speed/pressure).

(15) Supplier shall provide a detailed failure Modes, Effects, and Criticality Analysis (FMECA) document evaluating failure modes that can lead to gas turbine distress or damage.

(16) Supplier shall provide a detailed technical discussion on drains to be installed.

5.0 INSTALLATION

5.1 Installation shall be done with user's labor and utilizing seller's field supervisor.

5.2 The sellers supervisor will supervise setting of the skid, installation of fog manifolds, pre-commissioning checks, and testing of the fog system.

6.0 STARTUP, TESTING AND OPERATOR TRAINING

6.1 The manufacturer shall provide a Startup and Testing Form and a representative of the manufacturer shall be present during startup of the system. All functions of the Pump Skid shall be tested including high and low pressure shut-down, etc. All software operating parameters and set points shall be entered into the PLC and tested.

6.2 The manufacturer's representative shall train the owner's operation personnel in the basic functions of the fog system. Training to include classroom training and field training on operation and maintenance aspects of the system.

6.3 A final functional test of the equipment shall be performed by the manufacturer's representative and viewed by the owner's representative.

7.0 QUALITY REQUIREMENTS

7.1 Supplier's System Requirements

Quality System (QS)

a) The supplier shall have a documented quality system in accordance with the applicable requirements of "ISO 9001 Quality System" – model for quality assurance in design/development, production, installation, and servicing.

b) ISO 9001 Certification is a requirement for the seller. Copy of Certification must be provided with the proposal.

c) Seller must have at least five (5) years experience with fabrication and installation of high pressure fogging systems for Gas Turbine applications.

d) Products requiring electrical connection shall be listed and classified by Underwriters Laboratory Inc. Electrical panel enclosures shall be NEMA 4 rated and shall be approved by Underwriters Laboratory Inc. All products requiring electrical connection, which are located outside of enclosures, shall be NEMA 4 rated.

e) Seller shall provide a one year manufacturer's warranty for replacement of defective parts (FOB manufacturers factory) and one (1) year contractor's warranty for installation of replacement parts.

f) Seller shall provide copies of factory test report for Fog Pump Skids.

8.0 PERFORMANCE GUARANTEE

Seller should provide the following information:

1) Power Boost (additional power) guarantee in MW at the design point, along with detailed performance test procedure. This procedure must also include means of testing the system under prevailing climatic conditions that may not meet the "design wet bulb temperature".

2) Guarantee for maximum water flow rate of the fog skid.

3) Guarantee for max parasitic power consumed by the fog skid.

4) Guaranteed inlet differential pressure due to the presence of fog nozzle manifold.

APPENDIX A- DESIGN DATA

BUYER SUPPLIED DESIGN DATA	
(A) <u>DETAILS ON GAS TURBINE:</u> -Provide make, model of gas turbine - No of GT's to be fogged -ISO Power -ISO Heat Rate -ISO Air flow -Site Power -Site air flow -Site Heat Rate -Site rating conditions (site temp, altitude, etc.) (attach all performance curves available) including effect of Ambient temperature on power, Heat Rate, Airflow, etc. -Turbine Inlet Temperature -Gas Turbine fuel used -Details-Simple cycle/combined cycle -Operating duty of gas turbine (base/peak) -No. of starts/year, current running hours or EOH. (B) <u>DETAILS OF INTAKE SYSTEM</u> -Make, details of Air Filter System -Drawings of Air Filter System and Inlet duct details (very important) -Specification Sheets and data regarding inlet system design. (C) <u>SITE CLIMATIC CONDITIONS</u> -Max dry bulb temp/minimum DB temp -Max and minimum humidity -Special conditions of site -If possible, historical data of site temperatures and coincident relative humidity (Tabulation or Graphic format) -Site Attitude -Fogging system is to be designed for a wet bulb temperature depression of _____ C. -Site Rainfall, snow, earthquake, wind data	

APPENDIX B

TABULATION SUMMARY OF DATA FOR GAS TURBINE INLET FOGGING POWER AUDMENTATION SYSTEM

SELLER'S EXPERIENCE/SCHEDULE	
Name of Supplier:_____	
1. Sellers Experience/Schedule	
1.1 No. of gas turbine fogging systems sold. (Seller to provide detailed list)	
1.2 No. of years supplier has sold Gas Turbine Fogging Systems.	
1.3 Name, date, location and description of 1st installation	
1.4 Is seller ISO 9001 certified Yes/no (if yes, provide certificate).	
1.5 Delivery time after receipt of purchase order.	
1.6 Manufacturer of fog nozzle	
2.0 SKID DATA 2.1 Total number of skids 2.2 Weight per skid	
3.FOGGING SYSTEM DATA 3.1 Type of Power Augmentation System.	
3.2 Number of Nozzles	
3.3 Injection Water Pressure…(barg)	

APPENDIX B (CONTD) **Supplier:_____** 3.4 Inlet Water Pressure to Augmentation System (min/max) … (barg) 3.5 Type of Nozzle 3.6 Number of Fog Pumps 3.7 Sauter Mean Diameter (SMD32)……. micron 3.10 Nozzle Flow Rate, liters/min…(max/min) 3.11 Maximum Water Flow…(liters/min) 3.12 Number of skids/GT 3.13 Maximum Power Requirements…(KW) 3.14 Cooling Capacity…(C) 3.15 Number of Cooling Stages 3.16 Cooling Efficiency $(T_{amb}-T_{out}) / (T_{amb}-T_{wet\ bulb})$	

APPENDIX B (Contd)

Supplier Name:_____

4. FOG SYSTEM EQUIPMENT DATA

4.1 Nozzle Manifolds and Feedlines:

4.1.1 Number of nozzles manifolds

4.1.2 Number of nozzles in each manifold

4.1.3 Support struts and clamps…(type)

4.1.4 Feedlines and Supports Material…(ASTM)

4.2 Pump Skids:
Seller shall detail Manufacturer type, model, catalogue no., design, data and construction material for each item:

4.2.1 High Pressure Pump Units

4.2.2 Inlet manifolds and valves

4.2.3 Discharge water manifolds

4.2.4 Inlet water filter and manifold

4.2.5 Skid base plate dimensions…(M)

APPENDIX B (Contd) **Supplier Name:_____** 4.3 Electrical Equipment Seller shall detail Manufacturer type, model, catalogue no., design, data and construction material for each item 4.3.1 Electrical distribution board 4.3.2 Motor Control Panels 4.3.3 PLC (manufacturer and model) Seller shall provide names of PLC makes that it can supply 4.3.4 PLC communication port 4.3.5 Cables type 4.3.6 Electrical boards IP regulation 4.3.7 Motor Control panels IP regulation 4.3.8 Control Panels IP regulation 4.4 All the equipment, materials and accessories not listed above necessary to meet Contract requirements.	