

PREQUALIFICATION CRITERIA (TECHNICAL):

1. PARTY shall be having experience of not less than 5 years of supplying the similar or higher capacity units.
2. PARTY has to give reference of completing the commissioning of the similar or higher capacity units and running same satisfactorily during last one year.

PARTY's SCOPE

1. PARTY shall design, manufacture, inspect, test, paint, supply and transport to the site, erect and commission the complete VAM (Vapor Absorption Machine) with air cooling coil to be placed at existing filter house of Process Air Compressor at Ammonia-I plant of RCF, Chembur as per technical specification mentioned Article 7.

Vapor Absorption machine should have following specifications.

MANUFACTURED UNITS

- A. Description: Factory assembled and leak tested, packaged, water-cooled absorption water chillers, consisting of absorber / evaporator assembly, condenser / low temperature generator assembly, high temperature (steam-fired) generator, solution heat exchangers, solution and refrigerant pumps and motor, purge system, control panel with machine status, diagnostic display and safeties, interconnecting piping, absorbent, inhibitor and refrigerant, auxiliary components and accessories.
- B. Design Characteristics:
 1. For controlling the corrosion rate and increasing the life, chiller cycle shall be designed in such a way that maximum absorbent concentration and maximum temperature shall not occur simultaneously in the generators.
 2. Unit shall be capable of continuous operation from 10-100% capacity.
 3. Chiller shall be designed in such a way that at rated conditions, crystallization temperature should be at least 10°C below the operating temperature to avoid crystallization in varying load conditions.

PUMPS

- A. Solution and refrigerant pumps shall be centrifugal, canned motor type. Isolation valves should be welded at inlet and outlet to enable easy maintenance of the pumps. Pumps shall be hermetically sealed.

VALVES

- A. All valves used for adjusting the solution are fully welded to prevent leakage of air into the unit. Valves should not have actuators to avoid any potential air leakage. Additionally, all connections of valves to unit piping are fully welded.
- B. All isolation and service valves shall have double seal arrangement with one seal having no moving parts.

- C. The steam flow control valve shall be either pneumatic or electrical power / air fail to close valve.
- D. Non return valve shall be provided for vacuum pump.

SOLUTION AND REFRIGERANT DISTRIBUTION MEANS

- A. Gravity feed spraying technology shall be applied to solution spraying in evaporator, absorber and generator. Solution in spraying tubes shall spray downward to ensure good film thickness and better heat transfer. The system shall be of non-clogging design, specifically designed for the intended duty.

HEAT EXCHANGERS

- A. High Temperature Generator shall be a shell and tube heat exchanger. Steam shall pass and condense inside the tubes and the absorbent solution shall pass outside these tubes. The tubes shall be of Stainless Steel (SS 430 Ti) and tube sheets of CS.
- B. A low-temperature solution heat exchanger shall be an integral part of the machine to increase efficiency by pre-heating weak solution with strong solution.
- C. A high-temperature solution heat exchanger shall be an integral part of the machine to increase efficiency by pre-heating weak solution.
- D. A drain heat exchanger shall be an integral part of the machine to increase efficiency by pre-heating weak solution with condensed refrigerant from low temperature generator. This shall be a plate type heat exchanger. The plates shall be of stainless steel.
- E. A heat reclaimer shall be an integral part of the machine to increase efficiency by pre-heating weak solution with steam condensate from high temperature generator. This shall be a shell and tube type heat exchanger.
- F. Tubes in evaporator, absorber and condenser shall be plain or enhanced and of **(SS 316 L ERW)**.
- G. Eliminators shall be positioned to separate absorber from evaporator and in condenser from low temperature generator. Eliminators shall be constructed of stainless steel.
- H. Air Cooling Coil of SS 316L to be placed at existing suction filter chamber of Process Air Compressor to cool air to 15 deg. C by passing chilled water from VAM. The pressure drop on air side for Air Cooling Coil shall not exceed 30 mmWG.

2 BATTERY LIMIT

Following are the Battery limit of VAM system: -

- 1) Inlet/Outlet flange of cooling water including cooling water control valve.

- 2) Inlet/Outlet flange of steam / Hot water including control valve.
- 3) Inlet/Outlet flange of chilled water
- 4) Control panel
- 5) Electrical panel required for operation & control of electrical equipment & other accessories shall be in the scope of contractor and it should be flameproof.
- 6) Instruments / safety devices on chilled water / steam / hot water / CW pipe.
- 7) Single source incoming power cable shall be arranged by RCF up to the electrical panel mentioned in sr. no.5. Electrical power control panel & further distribution of power from panel to electrical equipments & associated accessories shall be in the scope of contractor. Party shall supply all the electrical panels, lighting fixtures, equipments including motors etc. of flameproof only. Motors shall be with protection of IP 55. Party shall submit the total load requirement of the VAM system for enabling RCF to decide the supply provision & the size of the cable.
- 8) Instrument air header tapping near the machine.
- 9) Provision of dedicated copper plate earthing pit for the purpose of earthing of the equipments shall be in the scope of contractor. Party shall ensure proper earthing to all equipments & Control Panels of the VAM system from this earthing pit.

3 **SUPPLY**

- 3.1 The complete VAM SYSTEM shall be designed / supplied / erected / commissioned with all its accessories and auxiliaries including the associated electrical, instruments & controls equipments. The VAM system shall be of steam fired type. However it shall be feasible to convert this into hot water type by simple modification at site, at a later date. Modification accessories and technical assistance shall be provided by party when needed. The extent of supply shall include but not limited to the followings:
 - a. **SOLUTION AND REFRIGERANT DISTRIBUTION MEANS**
Gravity feed spraying technology shall be applied to solution spraying in evaporator, absorber and generator. Solution in spraying tubes shall spray downward to ensure good film thickness and better heat transfer. The system shall be of non-clogging design, specifically designed for the intended duty.
 - b. Absorption heat pump consisting evaporator, condenser, absorber, generator with all safety devices, instruments, control equipment, internal piping and tubings.
 - c. Absorbent pumps with drive unit, base frame and other related items.
 - d. Refrigerant pumps with drive unit, base frame and other related items. Solution and refrigerant pumps shall be centrifugal, canned motor type. Isolation valves should be welded at inlet and outlet to enable easy maintenance of the pumps. Pumps shall not be hermetically sealed and

- bearings and filters should be removable for maintenance Refrigerant pumps with drive unit, base frame and other related items.
- e. Vacuum pumps with drive unit, base frame, non return valve and other related items.
 - f. Foundation bolts, nuts as required for pumps and other related equipment's.
 - g. Supporting structures with holding down bolts for piping.
 - h. All isolation valves within the battery limit.
 - a. All valves used for adjusting the solution are fully welded to prevent leakage of air into the unit. Valves should not have actuators to avoid any potential air leakage. Additionally, all connections of valves to unit piping are fully welded.
 - b. All isolation and service valves shall have double seal arrangement with one seal having no moving parts.
 - i. All companion mating flanges,
 - j. All instruments, accessories, control panel, safety interlock system, power distribution box, erection material like control cable and power cable, impulse pipe, isolation valves, fittings, cable glands, support for cables, pipe and instruments etc necessary for smooth and safe operation like start up normal running, shut down emergency shutdown etc. to make the system complete.
 - k. All electrical items related to the system including control panel.
 - l. Special tools and tackles required.
 - m. Spare parts required for two years (As per Annexure-III) trouble free operation as well as other spare required.
 - n. Shop painting.
 - o. The steam flow control valve shall be either pneumatic (air fail to close valve) or operated by electrical power.
 - p. Cooling water control valves.
 - q. On site Conversion Kit for Hot water fired system.
 - r. Chemicals (LiBr etc) required for running the system.
 - s. PARTY shall grant and/or arrange from licenser necessary license, rights, patents of VAM System.
 - t. PARTY shall also quote for **One spares set** of critical parts / accessories with details, required for operation. List of suggested critical spares & item wise rate shall be quoted separately.
 - u. PARTY shall supply chemicals used in the system for first charge. Additionally PARTY should specify annual consumption of required chemicals and shall item wise quote for the same separately.
- 3.2 Design Characteristics:
- a. For controlling the corrosion rate and increasing the life, chiller cycle shall be designed in such a way that maximum absorbent concentration and maximum temperature shall not occur simultaneously in the generators.
 - b. Unit shall be capable of continuous operation up to 110% capacity.

- c. Chiller shall be designed in such a way that at rated conditions, crystallization temperature should be at least 10°C below the operating temperature to avoid crystallization in varying load conditions.

4 **SERVICES**

- 4.1 Prepare and submit to the RCF, the overall network indicating complete details of various activities of project as per the network for its proper implementation.

4.2 **ERECTION**

- 4.2.1 Provide erection services including supervision for VAM system as given below:

- 1) Transportation of the machine to site.
- 2) Unloading of the machine.
- 3) Taking the machine on the foundation and its erection.
- 4) Removal and re-assembly of existing structural like beams, sheets, staircase and doors.

- 4.2.2 Crane for unloading shall be provided on chargeable basis if available. However any delay due to non-availability of crane shall not be to RCF account.

4.3.1 **COMMISSIONING**

- 4.3.2 Party shall take up and complete the commissioning as per schedule given by the RCF. Party shall also provide supervision services for commissioning as well as **GUARANTEE TEST** as required by the RCF.

- 5 **CONVERSION TO HOT WATER:** - Party shall also provide services / technical assistance to RCF at the time of conversion of machine to hot water fired type.

6 **DESIGN ENGINEERING DOCUMENTS**

PARTY shall supply specification of equipments, data sheet and engineering drawings with detailed calculation and documentation for VAM SYSTEM

- 6.1 The following documents shall be furnished after award of the contract (within six weeks of LOI in 6 copies):

- I. **Process**

Process flow diagrams with Energy balance, P & I Diagram

II. Mechanical

Civil scope (foundation) layout drawings with load data.
General arrangement drawing
Engineering flow diagram.
Maintenance Manual
Purchase Specification for:

- a) Fabricated Equipment
- b) Vendor Equipment (literature & catalogue also)
- c) Insulation Schedule

III. Electrical

Basic Design Philosophy
Single Line Diagram
GA & dimensional drawings of electrical equipments & electrical control panel
Load List
Bill of Materials
Purchase Specifications, literature & catalogue for Electrical Items
Power supply & distribution layout.
Wiring diagrams of Power control for motors & other electrical load.
Certification by CMRI Dhanbad for all the flameproof electrical panels, equipments, motors & accessories.

IV. Instrumentation

List of instruments and accessories with brief specification including sizing calculation of control valves and safety valves.
Purchase Specification, literature & Catalogue for all instrument item
Loop Diagram
Logic and safety interlock diagram
Power Distribution diagram
Control panel diagram along with panel pressurization interlock.
Instrument installation diagrams
Instrument hook-up drawings

V The following final documents shall be furnished along with supply of package:

- a. All final approved drawings including wiring diagrams related to Electrical & Instrumentation / data sheets -One reproducible+6 set print
- b. Operating manuals - 12 sets
- c. Inspection test reports - 6 sets

- d. Guarantee certificates - 6 copies.
- e. Operation & maintenance manual for motors, electrical control panel & associated accessories
- f. Bill of material & essential spares list for electrical equipment for two years trouble free operation
- g. Material Safety Data Sheets (MSDS) for all the chemicals prescribed by the PARTY to be used in VAM.

6.2 Any item not indicated above but is essential for safe and smooth operation of the system shall also be within the scope of the PARTY.

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7 TECHNICAL SPECIFICATION

7.1 PROCESS: -

VAM system has been envisaged for indirect cooling of Process Air Compressor suction ambient air with the help of chilled water re-circulation at existing air filter chamber to 15 deg. C.

Process specification of the system shall be as below:

7.1.1 Process Design basis:

Rated Air Flow at suction of PAC	- 22079 m ³ /hr
Variation in Air Flow at suction of PAC	- 15000 m ³ /hr to rated flow.
Temperature of Air	- Ambient (@ 35 deg C)

Specifications for the following shall be given by the PARTY in tabular form-

A CHILLED WATER CIRCUIT :

- 1 Capacity in TR
- 2 Chilled water flow M³/hr
- 3 Chilled water temperature °C (Inlet/Outlet)

B COOLING WATER CIRCUIT :

- 1 Cooling water flow rate M³/hr
- 2 Cooling water temperature °C (Inlet/Outlet)
- 3 Fouling factor m²hr °C /KCal

C STEAM CIRCUIT :

- 1 Steam consumption : Kg/hr
- 2 Steam inlet pressure Kg/cm²(g)
- 3 Condensate temperature °C

D ELECTRICAL CIRCUIT :

- 1 Power supply details
- 2 Absorbent pump motor rating KW
- 3 Refrigerant pump motor rating KW

4 Vacuum pump motor rating KW

E PHYSICAL DATA (INDICATIVE):

1 Length X Width X Height M

2 Weight Operating / Shipping Ton

3 Space for tube cleaning (any one side-Lengthwise) M

4 Minimum clearances required **around** the VAM

F TURNDOWN RATIO

The turndown ratio of the vapor/vacuum refrigeration shall be 10 –100% step less.

7.1.2 **Safety aspects:**

All electrical motors, lighting etc is suitable for the operation in hazardous area as the vapour/vacuum refrigeration unit shall be located within the area of Ammonia - 1 plant. All these shall be flameproof with due certification from CMRI, Dhanabad

7.1.3 **Utilities:**

The following utilities shall be made available by RCF at the battery limit of the vapor absorption machine / unit. (Inlet/Outlet Flange of machine)

Cooling water

Source	: from cooling water Header
Inlet temperature	: 28-32 °C
Outlet temperature	: 35-41 °C
Inlet pressure	: 3.5-4.5 Kg/cm ² g
Outlet pressure	: 1.0-2.0 Kg/cm ² g

Steam

Pressure	: 3-4 and 9-12 Kg/cm ² g
Temperature	: 130-150 °C & 170-200 °C

Hot Water (Process Condensate)

Pressure	: @7 Kg/cm ² g
Temperature (Inlet/Outlet)	: 100°C / 90°C.
Quantity	: 15 – 20 M ³ /Hr.
Quality	: NH ₃ : 20 ppm, CH ₃ OH: 10 ppm & CO ₂ 10 ppm (Occasional variations in quality of condensate are possible)

Electrical Power : 415 V with three phase supply.

7.1.4 Chemicals:

The party shall supply chemicals used in the system for first charge as well as **spare annual consumption** if required.

The party shall also furnish type of hazards involved and precautionary measures to be undertaken in handling all chemicals (MSDS).

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7.2 MECHANICAL

7.2.1 Vapor Absorption Machine(Absorption Heat Pump) :

Qty : 1 No
Service : To supply Chilled water to purchaser Process Air Compressor filter house through coil in order to cool down Process Air Compressor suction air temperature from 35 to 15 deg C

Vibration level : Negligible (below 40 μ)

Evaporator :
Material of Construction : SS-316L tubes,
Design/test pressure : Party should specify

Absorber
Material of Construction : SS-316L tubes,
Design/test pressure : Party should specify

Generator
Material of Construction : SA-430 Ti tubes,
Design/test pressure : Party should specify

Condenser :
Material of Construction : SS-316L tubes
Design/test pressure : Party should specify
Shell : IS 2062 or Eqi.

Pumps for VA Machine :

Data	Absorbent Pump	Refrigerant Pump	Vaccuum Pump
Quantity	1	1	1
Fluid to be handled	LiBr	H ₂ O	vapor
Type of pump	canned	canned	
Make(Prefebly)	Teikoku Japan	Teikoku Japan	Hindhivac

7.2.2 Supply and fixing all supports, foundation bolts, pipe supports, cable rack protective guards, nuts, bolts gaskets etc. as required within the battery limit shall be supplied by bidder.

7.2.3 Party shall supply civil scope for the entire system. Civil work shall cover static and dynamic loading also. RCF shall arrange design/drawing on the basis of scope furnished by the bidder and civil work shall be carried out by RCF. The bidder shall supply all holding down/anchor bolts.

7.2.4 **Inspection and Testing :**

7.2.4.1 All equipments shall be subject to shop inspection by Purchaser's inspector who shall have free access at all reasonable times to the party's works while work is on , or the testing of the equipment is being done. The party shall furnish the inspector with all the necessary certificate forms for the pressure vessels, reasonable proof of materials and so forth to verify that the requirements on this specification are met. All the equipments with accessories shall be offered for the final inspection.

7.2.4.2 The fabricated equipments shall be subjected to following Stage wise inspection by RCF inspectors

- a) Pressure Test
- b) Helium Test

7.2.4.3 The party shall give 2 weeks advance notice for inspection to the CMM (Purchase) / Operation Manager (Ammonia 1 Plant) and inspector of client and also furnish schedule of stage wise and final inspection.

7.2.4.4 All the electricals, instruments and other accessories shall be subjected to visual examination and identification with party certificates as per relevant codes before performance testing.

7.2.4.5 Acceptance of shop tests or shop inspection by Purchaser's inspector shall not relieve the party of responsibility to fulfill the guarantee specified.

7.2.4.6 The final acceptance test shall be carried out at the site after erection.

7.2.4.7 The party shall submit the inspection/test reports as follows:

- a. Material certificates
- b. Results of nondestructive inspection.
- c. Records of dimensions.
- d. Results of hydraulic tests and pneumatic tests whichever applicable as per relevant code.
- e. Performance test report and
- f. Guarantee certificate.
- g. Test report/guarantee certificates for all bought out items.
- h) Test reports for Electrical & Instrumentation equipments

7.2.5 **Preparation for despatch:**

- 7.2.5.1 After the completion of inspection and tests, all exposed-machined surfaces shall be cleaned and suitably protected to prevent corrosion.
- 7.2.5.2 All un-machined exterior surfaces shall be shop painted with two coats of red oxide primer and then finally painted with epoxy paint.
- 7.2.5.3 All openings shall be provided with metal closures.
- 7.2.5.4 Small easily damageable parts shall be packed separately marked with item no. and sr no. for identification.
- 7.2.5.5 The flanges shall be covered with flange protectors not smaller than the flanges OD and securely attached.
- 7.2.5.6 All equipments of the package unit shall be suitably packed for outdoor storage for at least one year.

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7.3 **INSTRUMENTATION**

7.3.1 **Salient Design Philosophy**

- 7.3.2 All instruments and control system shall be suitable for working in explosive hydrogen and ammonia atmosphere and must comply with group II-C area of IEC-79.
- 7.3.3 All temperature elements head assembly, field instruments etc. must be ex-proof conforming to Exd-II-C-T-3 area as per cenelec standard 50018 or as per IS-2418 Gr. II-C. Ex-proof certificate from competent authority must be furnished. Ex-proof certification as per IS-2148 Gr. II-C shall be acceptable.
- 7.3.4 All field transmitters shall be of electronic type.
- 7.3.5 All field electronic transmitters shall operate on two wire system with 24V DC power supply from remote panel mounted receiver instruments.
- 7.3.6 All temperature elements shall be RTD as per DIN 43760.

Intrinsically safe type system shall be considered for all closed control loops and open loops except temp. Monitoring loops since Ex-proof Temp. Elements are being envisaged. All field transmitters shall be intrinsically safe conforming to ex ib II-C-J-3 area as per cenelec std: 50020 and compatible with intrinsic safety barriers. All necessary safety barriers are in the scope of Vendor.

- 7.3.7 Control valve positioner shall be Smart Electronic with built-in Position feedback & limit switches and shall be of intrinsically safe design to suit the area classification.
- 7.3.8 Control system shall be implemented in a PLC for close loop control, open loop monitoring, open loop monitoring and Interlocking & Trip system, having minimum 17" colour Operator panel with touch screen and built-in Alpha-numeric keypad for data feeding. This PLC and Operator Panel shall be located in the existing local control panel of Process Air Compressor (enough space is available).
- 7.3.9 All the jobs related with control system installation, mounting etc at site in the place & location provided by RCF is in the scope of Vendor. Cabling from VAH machine to the PAC Local Control Panel is in the scope of Vendor. All the hardware including cables required to complete the job is in the scope of Vendor. All Digital Outputs shall be executed through interposing relays (with LED indication, 24 V DC operated).
- 7.3.10 Solenoid valve if any shall be ex-proof complete with ex-proof cable gland (Double Compression type MOC – SS316) as per IS-2148 Gr. II-C.
- 7.3.11 All transmitter bodies shall be of SS with integral SS manifold wherever necessary and double compression type 316SS cable gland with IP-65 protection class.
- 7.3.12 Copper and copper alloys shall not be used for any part of the instruments and accessories either in contact with the process fluid or external atmosphere.
- 7.3.13 Power supply to instruments, alarm and interlock shall be 115V AC 50 HZ.
- 7.3.14 Instrument air pressure available at the battery limit of the VAM system shall be 5 Bar.
- 7.3.15 Make of instruments shall be as per vendor list indicated. For any other make prior approval must be taken from the RCF.
- 7.3.16 20% built is spare terminals, lamps, annunciation etc. must also be provided for future addition or as a standby spares.
- 7.3.17 All the measurement shall be done using Transmitters. Inputs for alarm and tripping shall be generated in the PLC by providing soft set points. No passive devices like pressure / level switches shall be used.
- 7.3.18 Repeat potential free contact for remote indication on CCP of the following three operating conditions of VAM machine shall be provided
- i) Machine 'on' indication
 - ii) Machine 'off' indication
 - iii) Machine 'trip' audio visual alarm indication
- 7.3.19 The pneumatically operated control valve of steam / Hot water and cooling water shall be of the following sizes: -
- a) Steam / hot water control valve 6"
 - b) Cooling water control valve 8"

- 7.3.20 Local Instruments like Pressure Gauges / Temperature Gauges / Level Gauges shall also be provided at all the measuring point tapping in addition to Transmitters.
- 7.3.21 All the events as well as critical inputs and outputs shall be provided with Audio / Visual Alarm Annunciator windows. Alarm Annunciator is in the scope of Vendor.
- 7.3.22 List of Instrument provided in the system shall be enclosed in the offer giving all the functionality of that measuring point.
- 7.3.23 Separate devices shall be provided for control / Monitoring / Alarm / Trip circuits to avoid single point failure.

7.4. **Technical requirement**

- 7.4.1 Alarm system:- The alarm system shall be of solid state type and will operate on 115 V, 50 Hz AC supply. First trip alarm sequence shall be as per ISA-S 18.1 Sequence F-3A and for normal alarm it shall be as per ISA-S18.1 sequence 'A'. Fault contact shall open on alarm condition. The Annunciator shall be equipped with auto reset feature.
- 7.4.2 Interlock System
This shall be implemented in the state of the art Programmable Logic Controller with graphic interface for operation. Programming Software shall also be provided with the supply of the system. Man Machine interface shall be minimum 17" size colour LCD Operator Panel with provision for Alpha-numeric keypad for easy data entry. This interlock system shall have standard direct connectivity to the plant DCS through standard communication protocol using Ethernet connectivity.
- 7.4.3 Control valve: Shall be pneumatically operated. Valve will be sized for minimum pressure drop and at the design maximum flow rate. Shut down valve shall be of the same size as the line size up to 100 NB.
Body material shall be as per piping material. But trim material shall be of 316 SS. Trim with stellited facing shall be employed when the pressure drop across the valve is more than 10 Kg/Cm². Valve positioner shall be used with all control valves.
- 7.4.4 Pressure Gauge: Shall be sized provided with Bourdon sensing element 150 mm dial, die cast aluminum case with epoxy paint, wetted part and bourdon material AISI-316 SS.
- 7.4.5 Solenoid valve: Ex-proof with class F- insulation. Body and trim material : 316 SS.
- 7.4.6 Dial thermometer: 150 mm dial Hg filled type. Thermowell made of bar stock to suit length and material : AISI-316 SS.

7.5 **Erection Material**

7.5.1 **Control Cable**: 1.1 KV grade 1.5 mm² copper conductors in twisted pairs aluminum shielding with drain wire armored and PVC sheathed. Manufacturing and testing as per IS-1554. Overall sheath shall have F.R.L.S. properties. Test certificate shall be furnished.

7.5.2 **Power Cable**: 1.1 KV grade 1.5 mm² copper conductors PVC sheathed. Overall sheath shall have FRLS properties, manufacture and testing as per IS-1554. Test certificate shall be furnished.

7.5.3 **Cable Tray**: Aluminum (.99% pure)

7.5.4 **Cable Gland** : SS 304

7.5.5 **Tubing**: ¼” OD 316 SS tubing conforming to ASTM-A-269.

7.5.6 **Fittings**: Forged 15 mm. S.W. ANSI-3000 Ib class.

NOTE: All carbon steel fittings, valves, pipes coming on steam services must be supplied with IBR certificate in form IIIC.

7.6 **Vendor List**

Instrument and accessories

Pressure Gauge	M/s. General Instrument / M/s. Waree / M/s. A.N. Instruments / M/s Mass / M/s Manometer.
Dial Thermometer	M/s. General Instrument/M/s. Guru Marketing/M/s. A.N. Inst.
Electronic Pr. & D/R transmitter (Capacitance type)	M/s. Emerson./M/s. Yokogawa / M/s. Honeywell M/s Siemens / M/s Chemtrols / M/s Invensys
PLC	Rockwell / Siemens / GE Fanuc
R/T & T/G element	M/s. General Inst./M/s. Detriv/ M/s. Electric & Electronic Corpn.
Level Gauge	M/s. Technomatic / M/s. Chemtrol/M/s. R. Dutt
Safety Valves	M/s. Moorco/M/s. L&T/M/s. Keystone/M/s. FMC Sanmar.
Control valve with positioner	M/s. Masoneilan/M/s. I.L./M/s. Dembla/M/s. Fisher Xomox
Torque tube level transmitter	M/s. Masoneilan/M/s. Chemtrol

Air pressure filter regulator	M/s. Placka/M/s. Savo Norgen
Annunciator	M/s. IIC/M/s. ICA/M/s. PIRI
Control Panel	M/s. ICA/M/s. Jaisun Hutchison
Solenoid Valve	M/s. Asco India/M/s. Herion
Smart Positioner	M/s. Dresser/M/s. IL/M/s. Fisher / M/s Siemens
Relay	M/s. Jyoti/M/s. OEN/M/s. Omron
Push Button/Lamp Selector Switch	M/s. English Electric/M/s. Siemens/M/s. L&T
Local D/P Indicator	M/s. Switzer/M/s. Toshniwal

Erection Materials

Signal Cables	M/s. General Instruments/ M/s. Associated Flexible/ M/s. Associated Cables
Control Cables	M/s. Associated Flexibles / M/s. Associated Cables
Terminals	M/s. Phoenix / M/s Wioldmuler
Pipe Fittings	M/s. Eby / M/s. Echjay / M/s. Metal Forging
Tube Fittings	M/s. J Rita / M/s. Excellicer Engg:/ M/s. Reliance Engg. & Electrical Corporation
Isolation Valve	M/s. Technomatic / M/s. L&T / M/s. Insaco
Aluminum Cable Tray	M/s. Hopes Metal / M/s. Sadhana Engg./M/s. Delta

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8.0 GENERAL INSTRUCTION TO PARTY

- 8.1 Metric system shall be adopted in preparation of all design, engineering and drawings, including piping and tubing schedules.
- 8.2 Any Future Correspondence shall be addressed in writing to the following address with a copy to CMM (Purchase):

Operation Manager
Ammonia 1 Plant
Rashtriya Chemicals & Fertilizers Ltd.
Chembur, MUMBAI-400 074

8.3 The Party shall acquaint himself with the conditions/limitations and official regulations under which or conforming to which the services are to be performed and shall carefully examine all information as may be furnished to them from time to time. For party's information, an indicative list of the applicable Indian Acts, rules and regulations governing the construction and operation of chemical factories in Maharashtra are given in Annexure-I. Failure to comply with above requirements shall not relieve the PARTY's obligations.

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9.0 OBLIGATIONS OF PARTY

9.1 PARTY shall carry out the job as per the scope till satisfactory completion of commissioning and agreed guarantees.

9.2 Know-how and technical information

PARTY shall agree to supply the VAM SYSTEM for AMMONIA -1 PLANT and shall grant license and/or arrange from licensor to RCF a right to use the unit, its KNOW-HOW and ALL TECHNICAL INFORMATION.

9.3 PARTY shall be fully responsible for all guarantees and liabilities.

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10.0 OBLIGATIONS OF RCF

10.1 RCF shall supply to the PARTY the necessary data.

10.2 RCF shall provide skilled/unskilled operating personnel, utilities of required quantities/quality during COMMISSIONING and GUARANTEE TEST of the system.

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11.0 COMPLETION OF ERECTION, COMMISSIONING AND GUARANTEE TEST RUN

11.1 Mechanical Completion

11.1.1 As soon as the VAM system is mechanically complete along with pre-commissioning activities, RCF shall issue a certificate to PARTY indicating the date to be considered as the date of MECHANICAL COMPLETION for the VAM system.

11.1.2 The date when the certificate of MECHANICAL COMPLETION as provided above is issued by RCF shall be the date of MECHANICAL COMPLETION.

11.2 **Commissioning**

PARTY shall assist RCF for commissioning and for conducting GUARANTEE TEST of the VAM SYSTEM by providing supervision services by competent personnel.

PARTY shall prepare detailed procedures for conducting guarantee test requirements beforehand in consultation with the RCF so as to correctly evaluate the agreed guarantees.

11.3 **GUARANTEE TEST RUN**

11.3.1 After VAM system has operated steadily for about a week, RCF and PARTY shall decide the date of commencement of GUARANTEE TEST RUN.

11.3.2 GUARANTEE TEST RUN shall be conducted under normal operating conditions without the help of any installed stand-by equipment and/or machinery. Sufficient and necessary measurements shall be taken to ascertain the test results.

11.3.3 GUARANTEE TEST RUN shall be carried out by operating VAM system for 72(Seventy Two) consecutive hours according to PARTY's instruction and recommendations.

11.3.4 Any Interruption of durations less than one hour shall be ignored.

11.3.5 During the GUARANTEE TEST RUN, average results obtained during the period shall form the basis of comparison between actual performance and PARTY's performance guarantees. The VAM system shall be deemed to have completed a successful GUARANTEE TEST RUN if these average results are equal to or better than the guarantees stated.

11.3.6 If interruption of more than one hours occurs before 72 (seventy-two) hours, PARTY shall repeat the GUARANTEE TEST RUN for a maximum of 3 (Three) times and the results of these test run shall be considered for determining guarantees.

11.3.7 The measuring tolerances shall be as follows:

- | | | | |
|----|---------------------------------------------------------------------|-----|-----------------|
| a) | Tolerance for chilled water flow | : - | ± 0.5 % |
| b) | Tolerance for chilled water temperature
(By mercury thermometer) | : - | ± 0.1 °C |

11.3.8 Successful completion of Guarantee Test shall not relieve PARTY from obligation and responsibility in any manner with regard to modification/rectification/replacement to meet material and workmanship guarantee.

11.3.9 If PARTY fails to prove the guaranteed performance figures mentioned in article 11 then liabilities and liquidated damages as per Article 12 & 13 shall apply.

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12.0 WARRANTIES, GUARANTEES & LIABILITIES

12.1 Party shall offer the most economically designed package of VAM system with 7°C inlet temperature to suction air chiller and guarantee the performance of the unit in his scope.

12.2 Process Guarantee: - (To be demonstrated by the party at site)

The party shall perform the process guarantee test for the performance of the system and utility consumption for the proposed unit as given hereunder.

12.2.1 Chilled Water Temperature outlet of VAM : Not less than 7°C
Suction Air Temperature of PAC : Maximum 15 deg C (at Full Load including increased throughput).

Pressure drop across Suction Air Cooling Coil: 40 mmWC Maximum (at Full Load including increased through put).

12.2.2 Guarantee for consumption of utilities:

The supplier shall perform guarantee for consumption of the utilities with respect to Steam, Power and chemical consumption.

12.3 Mechanical Warranty

12.3.1 PARTY shall guarantee that all equipments, accessories shall be brand new and free from any defect, fault or deficiency in design, engineering, material, workmanship, construction, fabrication and manufacture and remain free from defects for a period of 12 MONTHS from commissioning of the VAM system or 18 months from delivery whichever is earlier **provided** that VAM system and associated equipments are installed, operated and maintained in accordance with instruction given by the PARTY.

12.3.2 If within the guarantee period stipulated above, any defect, deficiency or fault is found then PARTY shall, at its own cost, repair such defect, deficiency or fault as expeditiously as possible or replace by a new part provided that VAM system supplied by PARTY and associated equipments are installed, operated and maintained in accordance with the instructions given by PARTY.

12.4. PARTY shall be released from all obligations in respect of Process performance guarantees upon the occurrence of any of the following events:

- a) When VAM system in AMMONIA-1 PLANT has passed a successful GUARANTEE TEST RUN as defined in Article-11.3.0.
- b) If for reasons beyond the control of PARTY, VAM system in AMMONIA-1 PLANT has not passed a successful GUARANTEE TEST RUN within 12 (Twelve) months from installation of VAM system in AMMONIA-1 PLANT.
- c) When liquidated damage referred to in Article-12 have been paid.

12.5 **Design Guarantees**

12.5.1 PARTY shall prepare and be responsible for equipment specifications, design and engineering documentation for the VAM system. PARTY shall carry out detailed design and engineering with safe and sound engineering practices.

12.6 PARTY shall guarantee to supply documents to RCF progressively in line with the time schedule as per Clause 15 and to complete the supply of essential documents before expiry of 6 (six) weeks from the date of LOI / PO.

12.7 **Liability for VAM system**

In the event VAM system in AMMONIA-1 PLANT fails to achieve the guaranteed performance by reasons for which PARTY is responsible, PARTY shall at his own cost carry out all necessary remedial modifications so as to achieve Guaranteed Performance in further Test Runs or claim at RCF'S option liquidated damages on the basis of last test run as per Article-11.3.

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13.0 **LIQUIDATED DAMAGES**

13.1 The Guaranteed temperature of water shall be 7 °C at outlet of VAM system after its installation at AMMONIA-1 PLANT. In case the temperature is higher than 8.0 °C, PARTY shall carry out modifications/replacements of the equipment at their own cost in order to achieve the guaranteed cooling of suction air of Process Air Compressor to 15 deg. C maximum.

13.2 **LD for Performance**

For deviation from the guaranteed chilled water / process air compressor suction temperature liquidated damages shall be 5% of contract value for each full 0.5 (ZERO point FIVE) degree centigrade higher than the guaranteed temperature, in case temperature is more than one degree centigrade higher than guaranteed temperature, PARTY shall make good by modifying/replacing the VAM system at their own cost to meet this requirement.

13.3 Subject to other provisions, in the event that the performance guarantee relating to the VAM system are not fulfilled, PARTY shall arrange for the modification of the unit and arrange to perform subsequent guarantee test run so as to achieve a

satisfactory performance. However, in the event of the performance deficiencies being within the ranges, RCF shall have option of claiming agreed liquidated damages at the rates calculated suitably.

- 13.4 In the event that PARTY finds it necessary to have modifications and or additions to the VAM system to correct the deficiency in work, attributable to PARTY so as to enable the unit to meet performance guarantees, PARTY shall carry out necessary modifications, additions and or alterations free of cost to RCF

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14.0 LIMITATION OF LIABILITY

Notwithstanding anything contained elsewhere or implied to the contrary:

- 14.1 PARTY shall in no circumstance be liable to any indirect or consequential loss or losses of profit suffered by RCF.
- 14.2 RCF shall in no circumstance be liable to any indirect or consequential losses suffered by PARTY.
- 14.3 Total aggregated liability of PARTY, excluding liability under sub-clause 16.3 for patent, infringement, liability under sub-clause 13.2 for temperature shall be limited to 10% of Contract Value.

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15.0 TIME SCHEDULE

Time is the essence of the contract which is to be adhered to religiously. The PARTY shall prepare a detailed PERT/CPM network and forward to RCF within 15 days of receipt of LOI / PO and the schedule of work to be completed. Such schedule shall include all important mile stone such as completion of documents, ordering or materials, completion of dispatch, start and finish of erection at site etc. RCF will have the unfettered right to depute representative to PARTY's works to check adherence to such schedule.

- 15.1 The work connected with the entire Engineering service shall be completed by PARTY within 4 (Four) weeks from the date of LOI / PO.
- 15.2 Supply of VAM system and related equipments by CONTRACTOR shall be completed within 4 months from the date of LOI / PO.

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16. **PATENT AND OTHER RIGHTS**

- 16.1.1 PARTY shall fully indemnify RCF against any action claim or demand or costs or expenses, arising from or incurred by reasons of any infringement or alleged infringement of any letters, patents, registered design, trade mark or name, copy right or other protected right in respect of work or any arrangement system or method of using, fixing or working the equipment authorized or recommended by the PARTY.
- 16.1.2 In the event of any action being brought or any claim or demand being made against RCF on account of any such matters as aforesaid, PARTY shall immediately be notified thereof and they shall at their own expenses take all necessary steps either to make available to RCF all such rights or settle the claims themselves without affecting the RCF so as to make it not infringing or assist RCF in defending RCF against any claim or suit arising out of such infringement and indemnify the RCF for any direct cost resulting from any such legal action or claim for such infringement.

