TECHNICAL SPECIFICATION
FOR
AIR CONDITIONING SYSTEM

Project :	**1 X 18.5 MW BTG, UNIT-VI** **STEAM-CUM COGENERATION POWER PLANT**
Customer :	**M/s. NATIONAL ALUMINIUM COMPANY LTD. DAMANJODI, ODISHA**
Consultant :	**M.N.DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS**

Ref. Doc

TABLE OF CONTENT

CHECKLIST:

The following documents shall be submitted by bidder along with their offer:

Sl. NO.	Document Description	Attached (Yes/No)
1.	NO Deviation Format (Annexure-9)	
2.	Unpriced bid format (Annexure-1)	
3.	Signed & Stamped copy of BHEL's clarification issued against Pre-bid queries, if any.	
4.	Signed & Stamped copy of corrigendum, if any.	
5.	List of Recommended Spare attached	
6.	Signed & Stamped copy of Pre-Qualification Documents (PQC) along with supporting documents	

1.0.0. INTENT OF SPECIFICATION:

1.1.0. The intent of this document is to establish the minimum requirement of design, engineering, selection, manufacture, assembly, inspection, shop testing, shop painting, delivery FOR site properly packed for transportation, suitable packing for weather protection, transit insurance of all equipment, unloading at site, transportation to stores, safe storage at site, insurance during site storage, transportation from stores to site, erection, final painting, testing, commissioning and performance testing, handing over to customer/purchaser as mentioned hereinafter for the air conditioning system, which is part of Captive Power Plant (CPP) package, 1 X 18.5 MW BTG, Unit-VI Steam-Cum Cogeneration Power Plant at Nalco Damanjodi.

1.2.0. It is not the intent to completely specify all details of design, manufacture and construction. Nevertheless the equipment and installation shall conform to high standard of engineering and shall be capable of performing in continuous commercial operation in a manner acceptable to the Purchaser and end customer.

2.0.0 SPECIAL NOTES TO BIDDERS

2.1.0 This specification shall be read in conjunction with all its enclosures. In case of any discrepancy arising between this job specification & its enclosures, the most stringent of all (as determined by purchaser) shall be followed. In all cases, end customer's (M/s MND&C/NALCO) specification requirement enclosed in various annexures are binding and are to be followed by bidder. Further, if a requirement in this specification or any of the enclosures, calls for a decision from the Purchaser, it shall be bidder's sole responsibility to clearly bring out/highlight the same distinctively in his pre-bid queries, so as to enable purchaser to furnish their decision/clarification. If such issues/requirements are not duly addressed by bidder during the pre-bid stage and if such issues/requirements have been observed later during order execution stage, it shall be binding on the bidder to comply with the final decision made by the purchaser subsequently, without any cost, delivery, or any other commercial implications.

2.2.0 Any additional equipment, material, services etc., which are not specifically mentioned in this specification, but required to make the air conditioning system complete in all respects, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.

2.3.0 Any specific hardware/software/item/ etc. required as indicated in 2.2.0 above but not listed elsewhere in this specification or its enclosures, shall be deemed to be included in the basic price quoted by the bidder.
Also, all mounting hardware/ accessories/fittings/conduits/etc. required for above the E&C of the Air Conditioning System package shall be deemed to be included in the basic price quoted by the bidder.
Bidder, at no point of time, shall be eligible to raise any extra claim in this regard.

2.4.0 The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipments and the Air Conditioning plant as a whole. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the plant is fulfilled in every respect and a maximum of operational dependability and efficiency are assured.

2.5.0 Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.

2.6.0 By accepting the contract, the bidder shall be deemed to have accepted the obligation of supplying everything that is necessary for the purpose mentioned above, regardless of any omission in the specification or on the drawings for the fulfillment of complete main plant package.

2.7.0 Even though, the requirements are specified in detail to the extent possible, bidder to apply good engineering practices in the design, selection of equipment, manufacturing, procurement, transportation, fabrication, painting, erection, inspection & testing, commissioning of system etc., wherever same is not clearly spelt out.

2.8.0 Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.9.0 In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid.

2.10.0 All such clarifications required by the bidder shall be intimated to BHEL together as a single notice within a week of receipt of enquiry by bidder.
In case no such clarifications are sought during pre-bid stage, it will be assumed that bidder has no comments or observations on BHEL's specification and no deviations to the specifications will be taken by the bidder.

2.11.0 Bidder to quote strictly as per BHEL's price format. Failure to do shall make their offer liable for rejection. Any tampering/modification/change of the BHEL's price format is not allowed and is liable for rejection of bidders offer.

2.12.0 Incase Bidder is unable to offer due to any specific requirement of specification, Bidder may bring out the same in their regret letter. Otherwise it will be considered that non participation by the bidder is attributable to reasons other than any specification requirements.

2.13.0 Compliance with 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.
Accordingly, bidder to furnish their comments if any on this specification as a part of pre-bid query.

2.14.0 The design information, specifications and drawings indicate the "Minimum" requirements and are intended to enable Bidders to ascertain the extent of the work involved. Bidders are expected to supplement the information included in this specification as required and submit a comprehensive bid.

3.0.0 PROJECT DESCRIPTION

3.1.0 National Aluminum Company Limited (NALCO), a Government of India Undertaking and a Navaratna Company owns and operates a large integrated Mines-Alumina- Aluminum Complex in India.

3.2.0 As a part of NALCO's growth plan, it is planned to set up of one more Stream (5th Stream) in its Alumina Refinery under 3rd Phase Expansion at Damanjodi with Stream capacity of 1.0 MTPA and processing technology will be based on medium pressure digestion. To meet the above objective, it is planned to add one number Pulverised coal (PC) fired Steam generator of 300 TPH capacity and one number Condensing cum Extraction TG of 18.5 MW capacity in third phase expansion of existing Steam and Power Plant (SPP) at Damanjodi in Odisha in EPC mode and subsequently, order was placed on BHEL.

For Metrological data, please refer enclosed Annexure-6.

4.0.0 GENERAL REQUIREMENT

4.1.0 Air Conditioning system shall be designed to operate 24 hours per day and 365 days in a year.

4.2.0 The life span to be considered in the design, equipment and component selection shall be minimum of 20 years in existing industrial plant condition.

4.3.0 For the design of the plant, it is necessary not only to consider the requirements of operation, but also (by suitably planning the layout), the convenience of inspection, cleaning, maintenance and repair.

4.4.0 Equipment design and engineering shall incorporate adequate safety features (as per applicable specifications of respective equipment as well as Health, Safety and Environment Codes & Standards applicable for the subject project) to provide protection to operating personnel, equipment and environment.

4.5.0 In order to achieve the reliability, high efficiency and safe operation of the plant, it is also necessary to consider various precautions to safeguard the operating and maintenance personnel.

4.6.0 The design of the plant shall ensure that the plant can, in the state of normal operation, adapt itself variation within the allowable range of design.

4.7.0 Equipments installed outdoors shall be able to operate in all-weather conditions and to withstand the work site environment. For equipment in operation or in standby that may be influenced by direct sunshine, shelter or cover shall be provided.

4.8.0 The facilities shall be completed in a manner so as to require minimum time for hook up of the same with other systems

4.9.0 If during the execution of works, it is found that there is interference with other facilities/structures, the Bidder shall revise his design/detailed drawings to clear the interference and shall provide all necessary measures for the safety of structures under construction. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for the safety measures provided. If at any stage of work, any dismantling or modification or relocation of any facilities is required to be done to complete the work in bidder's scope and which has been agreed by the Owner, the same shall be done by the bidder at no extra cost or time implication to the Owner. All such changes will be executed only after the proposed drawings and work plan are approved by the purchaser.

4.10.0 The Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the Bidder on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the Bidder at his own cost to the satisfaction of the Owner. The Bidder shall also take all necessary safety measures at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power station.

5.0.0 BIDDER'S SCOPE OF SUPPLY AND ERECTION-COMMISSIONING

Following Type of Air Conditioning System are envisaged for various Buildings:

5.1.0 Following areas shall be provided with Centralised Air-Conditioning system by Vapour Absorption Machine (VAM) of 3x50% units :

S. No.	Area	Room inside DBT (°C)	RH %	Remarks
1	Control Room at EL. 8.50M in TG Building: • DCS Operator Room • Electronics Eqpt Room • VFD Room	23±2 °C	55 ± 5 %	• AHU (1x100%) based Air-conditioning System. • AHU shall be located in AHU room at EL. 8.5M in TG Hall adjacent to Control room.
2	Switchgear Room at EL. 3.5M in TG Building	`°C	70 %	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 3.5M in TG Hall adjacent to this switchgear room.
3	Switchgear Room at EL. 9.0 M in TG Building	32 °C	70 %	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 9.0M in TG Hall

				adjacent to this switchgear room.
4	TG Hall Operating Floor (Space between EL. 8.5m to 18M)	36 °C	--	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 8.5M in TG Hall. • Only operating floor from 8.5 to 18 m is considered for HVAC system. • Refer Note : 1 below
6	Chiller cum ESP Control Room Bldg. : • ESP/Chiller MCC & Transformer Room at EL. 13.5M.	32 °C	70 %	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 13.5M in ESP/Chiller Bldg.
7	Chiller cum ESP Control Room Bldg. : • FGD MCC Room at EL. 21.5M.	32 °C	70 %	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 21.5M in ESP/Chiller Bldg.
8	SWAS room	23±2 °C	-	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
9	Chiller cum ESP Control Room Bldg. : • Chimney Control Panel Area AT EL 0.0M	23±2 °C	-	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
10	Chiller cum ESP Control Room Bldg. : • SOx & NOx Room at EL. 0.0M	23±2 °C	-	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
11	Chiller cum ESP Control Room Bldg. : • Chiller Control Room at EL. 4.5M	23±2 °C	-	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
12	Chiller cum ESP Control Room Bldg. : • ESP/FGD Control Room at EL. 4.5M	23±2 °C	-	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below

Note 1: Since the existing TG hall of adjacent units are open, the treated dehumidified air may pass to the TG hall area of adjacent units as there is no closed boundary as of now. In view of above Bidder to demonstrate temperature of 30 Deg. At supply air grills outlet. However, conditioned air to be distributed near to the equipment through ductwork to the extent possible.
There will not return air in TG Hall. Heat Load calculation to be done considering 100% fresh air system.

Note 2: PAN Humidifier shall not be provided for areas catered with Ceiling suspended AHU (Fan coil unit).

5.2.0 Areas To Be Air Conditioned with Air cooled Package Air Conditioner (PAC):
Following areas shall be provided with air-conditioning system by Air Cooled Package AC units:

S. No.	Area	Room inside DBT (°C)	RH %	Remarks
1	Ammonia Storage Area: • Switchgear Room at EL. 4.5M	32 °C	70 %	Air cooled Package AC with 3x50% capacity.

5.3.0 Areas to Be Air Conditioned with non ducted Split Type Air-Conditioner (Please refer Annexure-3 for HLC.):

S. No.	Area	DBT (°C)	RH %	Remarks
1	LDO Pump House MCC Room	23±2 °C	--	2.0TR Split AC x 3 Nos. (2W+1S)
2.	LDO Pump House Control Room	23±2 °C	--	2.0TR Split AC x 3 Nos. (2W+1S)
3.	Control Room in Ammonia Storage Area	23±2 °C	--	2.0TR Split AC x 3 Nos. (2W+1S)

5.4.0 Area to be provided with Chilled Water Supply & Return Lines at Battery Limit:
Only Chilled Water Supply & Return Lines shall be provided (with isolation valve in supply & Return line) from the Centralized VAM Based AC system for following areas:

S. No.	Area to be provided with Chilled water connection	Remarks
1	Switchgear Room & Control Room in Ash Handling Control Room Bldg.	• Dedicated Chilled Water Supply & Return line (1 no.) separate for each of these areas shall be provided at Battery Limit of Bldg at one point. • Chilled Water Supply Temp. : 7 Deg C Max. • Chilled Water Tapping Shall be taken from Common VAM provided for TG Hall & ESP Bldg. • TG to be provided in each supply Line by bidder. • Isolation valve along with counter flanges to be provided in each supply & Return Line by Bidder.
2	Switchgear Room & Control Room in Coal Handling Control Room Bldg.	
3	Switchgear Room & Control Room in RCWPH Control Room Bldg.	

5.5.0 MANDATORY SPARE: NOT APPLICABLE

5.6.0 FIRST FILL OF CONSUMABLES

a) All the first fill of lubricants and consumables shall be supplied by bidder.

b) Price of these items shall be construed to be included in the main package price. No separate price for the same shall be offered.

c) The first fill of lubricants and consumables shall be supplied by bidder upon site readiness and as per BHEL's dispatch instructions.

d) All consumables as required for Commissioning and handing over to Owner shall be in Bidder's scope of supply.

5.7.0 STARTUP AND COMMISSIONING SPARES (ERECTION & COMMISSIONING SPARE):

a) All commissioning spares as required during erection and commissioning of the System is included in bidder's scope.

b) Bidder to ensure that all the spares are procured from the original equipment manufacturers (as per their recommendation) and shall make them available at site well before the start of commissioning activities.

c) Bidder shall furnish the list and details of Startup and commissioning spares during detail engineering stage.

d) All spares having a shelf life shall be dispatched to site as per site requirement only. The dispatch schedule of these spares shall however be planned in a way that in doesn't delay any commissioning activity.

e) Bidder shall also ensure supply of all startup & commissioning spares along with main equipment as per his experience, for replacement of damaged or unserviceable ones during the execution of the project by bidder at site, to avoid delay in the project schedule. The unused start-up and commissioning spares (given by bidder in his list) shall be the property of purchaser or end customer.

f) Price of all the above items shall be construed to be included in the main package price. No separate price for the same shall be offered.

5.8.0 SPECIAL TOOLS AND TACKLES:

a) All special tools and tackles, which are necessary for erection and commissioning and regular maintenance of the AC System, shall be supplied at site by bidder.

b) **Price of these items shall be construed to be included in the main package price. No separate price for the same shall be offered.**

c) All the special tools and tackles shall be shipped in separate steel tool boxes.

d) Bidder to note that if at a later stage the requirement of any other special tool & tackles is required for the Package, same has to be supplied by bidder without any delivery or commercial implication. Decision of the Purchaser regarding the requirement of any additional tools and tackles will be final and binding on the Purchaser.

e) All special tools and tackles shall be handed over to end customer warehouse / place informed by the Purchaser, prior to the issuance of the provisional acceptance certificate.

f) Following items, as a minimum but not limited to, shall be supplied by bidder. However, detailed list shall be furnished by bidder after award of contract for purchaser's review and approval:

S.NO	DESCRIPTION	QTY.
1	Box Spanners(1 no of each type & size applicable)	One Set
2	3/8 " (10mm) & 5/16" (8mm) Size valve Stem Socket Wrench (2 Pcs)	One Set
3	Flaring tools up to ¾" (19 mm) Size	One Set
4	6" Size Inside Caliper, outside caliper and Divider (3 Pcs)	One Set
5	12" size Depth Gauge	One
6	Allen Keys (1 no of each type & size applicable)	One Set

7	Instrument tube cuter up to 5/8" (16mm) size tube	One
8	1.5 Lbs .Hammer	One
9	Gas Charging manifold with Cylinder Adopter	One Set
10	Halide leak Detector	One
11	Assorted sizes of Half Union, Flared Tees Adopters, connectors, Flare Nuts etc. as reqd.	Ten
12	Grease gun	One
13	Center Punch	One
14	Torch with dry cells	One
15	Electric Tester	One
16	9- Blade feeler Gauge	One
17	12" long steel foot rule	One
18	Roll of insulation tape 3/4"	One
19	Temperature probe	One
20	Digital tachometer	One
21	Pitot tube	One
22	Digital anemometer	One
23	Tool box for the above	One
24	Analogue and digital multimeter	One
25	Tong testers	One
26	Clip Meters of different ranges	One
27	Allen keys	One
28	Hammers	One
29	Complete tool kit for the electrician comprising of screw drivers, testers ,pliers, spanners, cable cutter/stripper ,adhesive tapes etc	One

5.9.0 RECOMMENDED SPARES:

a) BIDDER shall furnish a list of recommended spare parts which the BIDDER considers necessary for the Air-conditioning system for two (2) years trouble free operation. The recommended spares that already appearing in list of mandatory spares SHALL NOT be included in recommended spares list. The list of recommended spares shall include such spares which are to be stored to achieve the plant availability level indicated by the BIDDER.

b) The recommended spares are not part of main offer and shall not be considered for bid evaluation. The unit price of each recommended spares shall be indicated separately in Annexure-1A and shall not be included in the main price.

c) These shall be ordered as per the requirement of end customer. The bidder shall provide the price validity for recommended spares for a period of two years from the date of purchase order.

d) The PURCHASER reserves the right to buy any of the recommended spare parts as considered necessary by him. The prices of recommended spares shall be consistent with those of start-up and essential spares.

e) Purchase of these spare parts will be covered by a separate order or an amendment to the contract. The recommended spares will be normally ordered only after the receipt of the complete information such as instruction manuals/general arrangement and spares identification drawings etc. for the equipment from the VENDOR to enable the PURCHASER to finalize the exact requirements. Subsequent to placement of order for recommended spares, VENDOR shall furnish details/ dimensional drawings for all such spares.

6.0.0 BIDDER'S SCOPE OF SERVICES

6.1.0 LIST OF MAJOR SERVICES INCLUDED IN BIDDER'S SCOPE:

I. Detailed Engineering
II. Submission and obtaining approval of all engineering documents
III. Engineering for procurement
IV. Ordering of all equipments and materials
V. Preparation of Documentation and obtaining owner/consultant approvals for the same
VI. Overall Project Management and progress reporting to owner/consultant
VII. Expediting suppliers and sub vendors
VIII. Procurement
IX. Manufacture, fabrication and assembly at works and site
X. Inspection and testing including third party Inspection
XI. Painting at works , painting at site including touch up paint
XII. Dispatch and transportation of equipments, consumables, construction aids and other material to site.
XIII. Establishment of site office complete with all facilities and communication network, as required
XIV. Storage, loading, unloading, security and handling at site
XV. Construction at site including fabrication, erection and installation of the complete Air Conditioning system.
XVI. Insulation with cladding and painting
XVII. Engineering for interfacing all inputs and outputs
XVIII. Hooking up of all services with battery limit Interfaces.
XIX. Site clearing and cleaning
XX. Mechanical Completion
XXI. Supply of consumables and spares during start up, pre-commissioning and commissioning.
XXII. Pre-commissioning activities and rectification
XXIII. Commissioning and reliability run
XXIV. Running of the AC plant as per Purchaser / PMC/ End customer's requirements till final handing over.
XXV. Handing over the plant to the owner
XXVI. Successful Performance guarantee testing
XXVII. Recommended list of 2- years spares
XXVIII. Supply of all test reports /certificates
XXIX. Providing as built drawings
XXX. Training of the Clients Engineering and Operating Personnel

Notes:

1. Bidder to note that the above list is not exhaustive and any other service required as per the intent of this specification / project requirements /good engineering practice shall be deemed to be included in bidder's scope without any commercial implication to the purchaser.

6.2.0 After award of work, before finalizing his layout especially the layout/levels of equipments cable/pipe routes and other services, the bidder shall carry out a site survey to identify the location & details of existing facilities that may interfere with his proposed facilities. He shall suitably modify his layout/levels to prevent dislocation of existing facilities without any commercial implication to the purchaser.

6.3.0 Arrange for services of manufacturer's installation / commissioning engineer at site during mechanical completion / pre-commissioning & commissioning of all the major equipment and systems All the cost including that towards boarding, lodging , servicing , Insurance , Local Travel , Service charges etc for arranging all the above visits shall be deemed to be included in the bidder's quoted price. Bidder shall not be eligible to raise any extra claim in this regard.

6.4.0 Bidder is also required to provide on the job training to Purchaser /End Customer's operation personnel by associating them in all the day to day pre-commissioning, commissioning and maintenance activities and process operations, however, responsibility for adequate manning the system shall be that of bidder. The cost of all such training shall be deemed to be included in the price quoted by the bidder. Bidder shall not be eligible to raise any extra claim in this regard.

7.0.0 CLARITY OF SCOPE HAVING INTERFACES WITH OTHER AREAS (SCOPE MATRIX):

7.1.0 MECHANICAL

MECHANICAL			
Item	**By BHEL**	**By Vendor**	**Remarks**
Supply & Installation of all Support structure like structural steel, anchor bolts, brackets etc for AC Equipments, Fans, piping, cabling, Split units, manual hoist etc	No	Yes	
Supply & Installation of Insert plates for support of intake air louvers / filters, back draft dampers / pressure relief dampers, fire dampers, wall mounted control panel etc.	No	Yes	-

7.2.0 ELECTRICAL, CONTROL & INSTRUMENTATION SYSTEMS

Sl No.	**Item**	**Engineering**		**Supply**		**ENC**	
		By BHEL	**By AC Vendor**	**By BHEL**	**By AC Vendor**	**By BHEL**	**By AC Vendor**
1.	AC system MCC Panel	Yes	-	Yes	-	Yes	-
2.	Cable Trays & GI condit for cables if both end equipment are in	Cable Trays and its supporting structural steel shall be in bidder scope for the cables supplied by bidder.					

Sl No.	Item	Engineering		Supply		ENC	
		By BHEL	By AC Vendor	By BHEL	By AC Vendor	By BHEL	By AC Vendor
	Vendor Scope						
3.	Local Control Panel for Centralised AC system (Common for Heater, Humidifier, ~~Fire Damper~~, Fresh Air Fan, DPS etc.)	-	Yes	-	Yes	-	Yes
4.	Power, Control & Signal Cables, if one end equipment are in BHEL Scope	Yes	-	Yes	-	Yes	-
5.	Power, Control and signal Cables if both end equipment are in Vendor Scope	-	Yes		Yes	-	Yes
6.	Cable Termination at equipment supplied by Non AC package Equipment supplier end	Yes	-	Yes	-	Yes	-
	Cable Termination at AC package Vendor supplied Equipment end	-	Yes	-	Yes	-	Yes
7.	Interconnecting Cabling between Fire alarm panel and AC system Fire Damper Panel		Yes		Yes		Yes
	Interconnecting Cabling between Fire damper panel to fire Dampers	-	Yes	-	Yes	-	Yes
8.	All the instruments & Control panels required for the operation the system	-	Yes	-	Yes	-	Yes
9.	Cable glands and lugs for BHEL supplied equipment end	Yes	-	Yes	-	Yes	-
	Cable glands and lugs for vendor supplied equipment end	-	Yes	-	Yes	-	Yes
10.	Earthing strips with bolts and nuts for various electrical equipment supplied by bidder.	-	Yes	-	Yes	-	Yes
11.	Earthing connection between earthing strips of equipment to the plant Earthing network located inside the plant room / vicinity of the equipment.	-	Yes	-	Yes	-	Yes
12.	Voltage Stabilizers for Split AC & Cabling between Voltage stabiliser and Split ACs	-	Yes	-	Yes	-	Yes
13.	MCB, Socket for Split ACs	-	Yes	-	Yes	-	Yes
14.	1-Phase Power receptacle near control room entry for Air Curtain's	-	Yes	-	Yes	-	Yes

7.3.0 CIVIL

CIVIL				
S No.	**Item**	**By BHEL**	**By Bidder**	**Remarks**
1.	All civil buildings	Yes	No	
2.	Making openings in walls for ducts/pipes/cables/equipment etc., and making them good after installation for the purpose of installing bidder's supplied items	No	Yes	
3.	Foundation blocks for AC machine ,Humidifier, Panel etc	Yes	No	
4.	Grouting/fixing of all equipment including supply of grouting material, insert angle/plain frames in the walls, support structures, foundations bolts, anchor bolts etc	No	Yes	
5.	Supply and fixing of framework for ducts , supply air grilles / diffusers, intake / exhaust air arrangement	No	Yes	
6.	Supply of vibration isolators / fixing hardware to be embedded / mounted on foundations	No	Yes	
7.	Designing and providing civil foundations/pedestals for Centrifugal fans, Making of various rooms.	Yes	No	Bidder to provide all the required inputs for designing the foundation etc. by BHEL.
8.	All false ceiling work, illumination except providing frames for grills / diffusers.	Yes	No	Suitable support for the grills / diffuser shall be by bidder.
9.	Condensate drain from plant rooms AHU rooms to the BHEL storm water drain. Condensate line shall have water seal arrangement and fully insulated.	No	Yes	
10	All the under deck insulation for the area exposed to sun	Yes	No	
11	Temporary scaffolding related to erection, testing & commissioning.	No	Yes	

7.4.0 TERMINAL POINTS

MECHANICAL					
S No.	**Item**	**By BHEL**	**By Bidder**	**Terminal Point**	
1.	Make up water (for Humidifier) To be taken from Cooling tower make up line. Covered in Sl 3 below.	Yes	No	Make-up water (service water or potable water) shall be made available at one place in TG Hall and ESP Bldg. Bidder to take further connection from that location to humidifier.	1. Line Size : During Detail Engineering stage 2. PMS : 11D or 11E (Annexure-17)
2.	Make-up Water for Dedicated RO system	Yes	No	Make up Water (Filtered Water) shall be made available inside AC plant room (0.0M in ESP Bldg.) for Dedicated RO system. Bidder to take further connection from that location to RO plant.	1. Line Size : During Detail Engineering stage **2.** PMS : 11D or 11E (Annexure-17)
3.	Make Water for Cooling Tower	Yes	No	Make up Water (Filtered Water) shall be made available at roof level (21.0M in ESP Bldg.) for Make Up water tank dedicated for Cooling Tower Make up purpose.	1. Line Size : During Detail Engineering stage 2. PMS : 11D (Annexure-17).
4.	Make up water for Package AC (Humidifier) in Ammonia Storage Bldg.	Yes	No	Shall be made available at one place inside AC plant room of ammonia storage bldg.	PMS : 11D or 11E (Annexure-17). Line Size : 1”.

MECHANICAL

S No.	Item	By BHEL	By Bidder	Terminal Point	
5.	MP Steam	Yes	No	Shall be made available at one place inside AC Plant room of ESP Bldg.	Parameters at terminal points Pressure Kg/CM^2 (a) / Temp ^{o}C / Flow T/ Hr Nor: 9.0 / 181 / 2.1 Min: 9.0 / 181 / Max: 9.0 / 181 / 2.5 Mech Design: 13.2 / 225 / 1. PMS : 11C (Annexure-17) for further piping. 2. Line Size: 3" . Refer P&ID of MP steam – Annexure-11. 3. Any equipment required to meet the steam inlet condition of VAM shall be included in bidder's scope. 4. IBR documentation for the MP steam piping, VAM and all the related items supplied by bidder shall be included in bidder' scope. 5. Insulation of MP steam piping from BHEL's terminal pint is included in bidder's scope.
6.	Instrument air	Yes	No	Shall be made available inside AC Plant Room in ESP Bldg.	Parameters at terminal points Pressure Kg/CM^2(g) / Temp ^{o}C Nor: 5.0 / Ambient Min: 4.0 / Ambient Max: 6.0 / 47 Mech Design: 9.0 / 65 1. PMS: 11E (Annexure-17) for further piping from terminal point. 2. Line size at terminal point : 1"

MECHANICAL					
S No.	**Item**	**By BHEL**	**By Bidder**	**Terminal Point**	
3.	Condensate transfer	No	Yes	Bidder to terminate the piping at one place near ESP bldg. Exact location shall be informed during detail engg stage.	1. PMS: 11B (Annexure-17) for piping up to the terminal point. 2. Line Size: 1". Refer P&ID of condensate (Annexure-31).

Notes:

1. Counter flanges at all the terminal points is included in bidder's scope.
2. Isolation Valve at all terminal points is in bidder's scope.
3. All necessary supports cross over, approach ladder required for the proper erection and operation of all equipment supplied by bidder shall be included in bidder's scope.
4. All lugs, glands and termination kits for the equipment supplied by the bidder shall also be included in bidder's scope.
5. Bidder to furnish utility list with the offer indicating the requirements of the above services.

8.0.0 APPLICABLE CODES & STANDARDS (Refer Annexure-22)

8.1.0 Following codes and standards (latest editions) including their latest addenda shall be followed unless otherwise specified:

1.	ISHRAE	INDIAN SOCIETY OF Heating Ventilation & Air-conditioning Enggs.
2.	IS:655 – 1963, Reaffirmed 1991	Metal Air ducts
3.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association.
4.	IS:277, 1992	Galvanized Steel Sheets
5.	IS:2062 , 1992	Steel for General Structural Purposes.
6.	IS:8148	Packaged Air Conditioners.
7.	IS – 325, 1996	Three phase induction motors.
8.	IS 8183, 1993, Reaffirmed 2004.	Bonded mineral wool
9.	IS:4671, 1984 reaffirmed 1990:	Expanded polysterene for thermal insulation purpose
10.	IS:1363, 1992 (Part 1of 2)	Bolts, Nuts, screws

11.	IS:1239, 1990 (Part-1)	Water piping-ERW, Bevel End
12.	IS:1239, 1992 (Part-2)	Mild Steel tubes & fittings
13.	IS:3589	Water piping-ERW FE 410MPa (Above DN150)
14.	IS: 659, 1964, reaffirmed 1991	Safety code for air-conditioning
15.	IS:6157, 1981 reaffirmed 1981	Valve inspection & Test
16.	IS:7613, 1975 reqaffirmed 1991	Method of testing of panel type air filter for AC
17.	IS:12065-1997	Permissible limits of noise level for rotating electrical machines
18.		ASHRAE HAND BOOK For design criteria

8.2.0 The motors shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

8.3.0 In case Indian Standards are not available, standards issued by IEC/BSI VDE/ IEEE/ NEMA or equivalent agency shall be applicable.

8.4.0 In case of any conflict between this specification and above codes, standards and guidelines requirements, the most stringent requirement of these shall govern and the decision of purchaser in the resolution of the any such conflict shall be final.
It shall be bidder's sole responsibility to clearly bring out/highlight the same distinctively in his pre-bid queries, so as to enable purchaser to furnish their decision/clarification. If such issues/requirements are not duly addressed by bidder during the pre-bid stage and if such issues/requirements are observed later during order execution stage, it shall be binding on the bidder to comply with the final decision made by the purchaser subsequently, without any cost, delivery, or any other commercial implications.

8.5.0 Other international standards may also be acceptable subject to their being equivalent or superior to those listed above, with prior approval of purchaser.

8.6.0 For provisions not covered by any of the codes & standards, applicable good engineering practices and norms shall govern.

8.7.0 Latest edition of applicable codes/Standards/Statutory Regulations referred to in the Bid Document shall correspond to the edition as on the date of issue of bid.

8.8.0 All addenda including the latest addenda to all the above codes and standards (latest editions) shall be followed by the bidder.

8.9.0 Any special approvals that may be applicable for certain items, like for explosion-proof items from CMERI-Dhanbad, etc., shall be have to be duly considered and ensured.

8.10.0 The bidder shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at his office.

8.11.0 STATUTORY REQUIREMENTS

Requirements of the following local statutory authorities (as applicable) shall be taken into account for compliance:

a. Factories Act
b. Indian Petroleum Rules
c. Indian Boiler Regulation Act (IBR)
d. Civil Aviation Rules
e. Indian Electricity Rules
f. Central Electrical Authority (CEA)
g. Director General, Factory Advice Service and Labour Institute, Bombay
h. Central Mines Research Institute (CMRI), Dhanbad
i. Other legislations relating to Environmental protection such as (but not limited
   - Hazardous wastes (Management and Handling) Rules 1989.
   - Water (prevention and control of pollution) Act, 1974
   - Water (Prevention and Control of Pollution) Act, 1977.
   - Environment (Protection) Act, 1986
   - Forest (Conservation) Act, 1980
   - Municipal Byelaws of Urban Development Authority of State Government for Buildings in Township.
j. Pollution Control Board.

9.0.0 SYSTEM DESCRIPTION & DETAILED SCOPE OF WORK

9.1.0 DESIGN GUIDELINES

9.1.1 Outdoor Design Condition

The design ambient temperature considered for calculation the heat load are as follow:

Description	Unit	Summer	Monsoon	Winter
Dry bulb Temp	°C	46.6	30.6	3
Relative Humidity (RH)	%	50	89	71

9.1.2 Indoor Design Condition

The Air conditioning system shall be sized to meet the following inside design conditions as

S. No.	Area	DBT (°C)	RH %	Remarks
1	Control Room at EL. 8.50M in TG Building: • DCS Operator Room • Electronics Eqpt Room • VFD Room	23±2 °C	55 ± 5 %	
2	Switchgear Room at EL. 3.5M in TG Building	32 °C	70 %	
3	Switchgear Room at EL. 8.5M in TG Building	32 °C	70 %	
4	TG Hall Operating Floor (Space between EL. 8.5m to 18M)	36 °C	--	
5	Chiller cum ESP Control Room Bldg. : • ESP/Chiller MCC & Transformer Room at EL. 13.5M.	32 °C	70 %	
6	Chiller cum ESP Control Room Bldg. : • FGD MCC Room at EL. 21.5M.	32 °C	-	
7	SWAS room	23±2 °C	-	
8	Chiller cum ESP Control Room Bldg. : • Chimney Control Panel Area AT EL 0.0M	23±2 °C	-	
9	Chiller cum ESP Control Room Bldg. : • SOx & NOx Room at EL. 0.0M	23±2 °C	-	
10	Chiller cum ESP Control Room Bldg. : • Chiller Control Room at EL. 4.5M	23±2 °C	-	
11	Chiller cum ESP Control Room Bldg. : • ESP/FGD Control Room at EL. 4.5M	23±2 °C	-	

9.1.3 Available Power Supply – Please refer attached Annexure-30.

9.1.4 Other design parameters as considered are as follows:

Sl No	Description	Value
1.	Lighting load	1.5 Watt/Sq.ft.
2.	Fresh air	1.5 air change per hour for all areas.
3.	Occupancy	• 8 Persons for Control Room • 2 persons for LT Switchgear Room
4.	Duct Velocity (Note 1 below)	• Supply Air Duct : Max 8 m/s • Grills/Diffusers : Max 4 m/s
5.	Margin	• Sensible Heat: 12.5 % • Latent Heat : 10.0 %
6.	Filtration efficiency	• Pre Filter: 90 % efficiency down to 20mic. • Fine Filter: 90 % efficiency down to 5mic.
7.	Water Velocity in cooling water lines	1-2 m/s
8.	Fouling factor for water cooled Condenser	0.0004 hr.m².ºC/kcal
9.		Thermal relief valves shall be provided for components that may be blocked in by isolation valves (including any cooling water return circuit piping of a cooler or a jacket).
10	Insulation for Personal Protection	Insulation shall be provided for personal protection for all surface temperature > 60oC.
11	Noise Level	Equipment noise level shall not exceed 85 db(a) when measured at a distance of 1.0 M from equipment skid in any direction.
12	Type of environment for selection of painting system	Corrosive

9.2.0 SYSTEM DESCRIPTION: Brief Description of Air-Conditioning System with VAM

9.2.1 The air conditioning system shall consist of three nos. (3x50%) of skid mounted Lithium Bromide absorbent based VAM machine. The VAM machine shall have its inbuilt skid mounted microprocessor /PLC based control panel for its operation & monitoring. MP steam for the operation of VAM shall be supplied through a PRDS system by BHEL.

9.2.2 The AC system shall be complete with VAM chillers having absorber, evaporator, generator, condenser, vacuum pump, chilled water and condenser water pumps, cooling towers, expansion tank, make up water tank, condensate tank, condensate water pumps, steam pipe line, PRDS, pipework with insulation, valves, strainers, fittings, electrics, instrumentation and control etc. as required. However, PRDS shall be BHEL's scope.

9.2.3 Dedicated AC Plant rooms shall be located at 0.0M lvl in Chiller cum ESP bldg. VAM, Chilled water pumps, Cooling water Pumps, Condensate transfer pumps, Condensate storage tanks, AC Panel etc. of respective buildings shall be located in this AC Plant room.

9.2.4 The VAM condensate shall be recovered in a $1M^3$ condensate storage tank. This condensate shall be pumped back to the plant condensate system by means of two numbers (1 W + 1S) of condensate transfer pumps. Pump head shall be approx. 7 kg/cm2 (a).

9.2.5 MP steam (9 Kg/cm2 (a), 181 Deg. C) for the operation of VAM shall be supplied through a PRDS system. Please refer Annexure-11 (P&ID of MP Steam).

9.2.6 The chilled water plant shall be selected to generate chilled water at a temperature of 7°C and the return water temperature to the chilled water plant shall be limited to 14°C maximum.

9.2.7 Chilled water from the VAM shall be circulated to the cooling coil of the AHUs through a closed circuit chilled water network consisting of chilled water pumps. These pipes shall be installed on available/dedicated supporting structure depending on the requirement.

9.2.8 An expansion tank of adequate capacity shall be provided for the makeup water (Filtered Water) requirement of the closed circuit chilled water network. **Dedicated portable RO system along with make-up water tank near expansion tank shall be provided by the bidder to maintain the quality of water (Refer Annexure-10).** Treated water from Portable RO shall be stored in Make-up water tank dedicated for Expansion Tank Make up purpose. Size/capacity of portable RO system shall be sufficient enough to cater to the requirement of AC system only. However, suggested flow shall be 1.0 CMH. Bidder to furnish details after award of contract for BHEL's review and approval. Please refer Annexure-35 for quality of filtered water available.

9.2.9 Supply and return of chilled water pipe and drain pipes within battery limits shall be insulated with Polyurethane foam.

9.2.10 Three (3) Nos. (2W+1S) cooling water pumps shall circulate cooling water to the chiller condenser through cooling tower.

9.2.11 Make-up water (Filtered water) will be provided for the condenser (cooling) water circuit make-up tank near the cooling tower. Bidder to consider Make-up water Tank dedicated for cooling tower make up purpose (refer Annexure-10). **Dedicated chemical dosing system shall be provided by the BHEL to maintain the quality of water.**

9.2.12 AHUs shall be placed in dedicated AHU rooms as mentioned in clauses above.

9.2.13 Each AHU room shall have the AHU, Local control cum annunciation panel, Common plenum, Fresh Air Fan-Filter unit, Dampers etc. to meet the air conditioning requirement.

9.2.14 All the AHUs shall be fed with closed loop chilled water piping from VAM. The closed loop chilled water piping will connect VAM to the respective AHUs. The layout of complete piping, piping support, insulation, instrumentation etc. shall be finalized during detail engineering stage.

9.2.15 Air from the conditioned space shall be cooled by exchanging heat with the chilled water inside Air Handling Unit (AHU) to maintain the specified design conditions.

9.2.16 Conditioned air from AHU shall enter into a common plenum with filters & shall be distributed into the conditioned space through a network of supply air ducts and Grills/Diffusers. The grills/diffusers shall be adjusted suitably to have calculated amount of conditioned air in a specific area.

9.2.17 Return air shall be routed back through return air grilles/diffusers into the space above false ceiling which shall act as a return air plenum and further to the respective AHU room due to the blower pressure. Blower static pressure rating to be suitably selected. Return air shall be sucked through insulated return air duct where false ceiling is not available.

9.2.18 A Fresh Air system comprising of fan-filter unit located in respective AHU room shall provide fresh air from outside. Required amount of fresh air as per ISHRAE guidelines is added here.

9.2.19 Volume control dampers shall be provided in all branches of main ducts from AHU to throttle the air volume.

9.2.20 A pan type humidifier shall be located in the AHU room and shall serve the humidity control requirement. Whenever the relative humidity of the conditioned space reaches the minimum allowable percentage of humidity, the humidifier shall be energized to restore the relative humidity by supplying steam to supply air on receiving signal from humidistat. The humidifier shall be such controlled that it shall not exceed the maximum allowable limit of relative humidity in the conditioned space. The humidifier shall be sized and designed accordingly. Make up water connection for Pan Humidifier shall be connected from nearest water line to suit-at-site condition.

9.2.21 A strip heater shall be located in the supply air duct to take care of the reheat control.

9.2.22 Three (3) way modulating valve shall be provided in the chilled water circuit of each AHU to control the flow of chilled water as per heat load variance.

9.2.23 Wherever any duct crosses wall/ceiling, fusible link type fire damper shall be provided at the separating surface.

9.2.24 Noise level of any equipment shall not exceed 85 dB(A) at a distance of one (1) meter from source of noise. However, inside the conditioned area, it shall be 50 dB(A).

9.2.25 All Interconnecting piping, valves, flanges, fittings, nuts, bolts, gaskets etc. shall be included as per Piping Material Specification (PMS) and Valve Material Specification (VMS) enclosed elsewhere.

9.2.26 Each air conditioning and air cooling system shall be interlocked with fire detection panel, so that in case of fire, the respective units are tripped automatically.

9.2.27 Supply air ducts shall be provided with air flow switch which shall trigger alarm in case of no/ low air flow.

9.2.28 Chipping of RCC slab for duct hangers is not allowed. Bidder shall provide anchor fasteners. Complete supporting structure for duct/cable/pipe/tubing etc. shall be provided by Bidder.

9.2.29 Contractor shall ensure that fixing arrangement of diffusers is such that there is no load on false ceiling. Size of diffusers shall match with light fittings. Diffusers shall be firmly fixed with the ductwork.

9.2.30 All the air-conditioning equipment, electrical, instrumentation and controls shall be suitable for electrical area classifications in which they are installed.

9.2.31 PLC/ Microprocessor based control system shall be provided for all air conditioning system.

9.2.32 All Foundations including requisite multi-layer virgin neoprene pads shall be provided by the Contractor between foundation blocks & equipment e.g. Chiller, AHU etc.

9.2.33 Air curtains shall be used to prevent air or contaminants from moving from Non-AC space to AC space.

9.2.34 For other technical requirements, refer attached Annexure-12 for Air Conditioning System.

9.2.35 Following Major equipment **(but not limited to) shall be included in bidder's scope of supply and Erection–Commissioning for centralized Air conditioning system :**

S. No.	Item Description	Configuration / Quantity	Location
1.	Skid Based Vapour Absorption Machine (VAM) – Minimum 220TR actual cooling capacity each.	3 x 50% (2W+1S)	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.
2.	Skid mounted chilled water pumps with motors and other accessories like strainers , valves etc.	3 x 50% (2W+1S)	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.
3.	Skid mounted Cooling water pumps with motors and other accessories like strainers , valves etc	3 x 50% (2W+1S)	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.
4.	Skid mounted condensate transfer pumps with drive motors and other accessories like strainers , valves etc	2 x 100% (1W+1S)	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.
5.	Compressed Air Piping	1 Lot	As per Layout Consideration
6.	Insulated Carbon Steel Condensate Storage Tank along with all associated	1 X 100% (1 Working)	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.

	instrumentation etc		
7.	FRP Cooling Towers	3 x 50% (2W+1S)	Open Terrace at EL 21.5M in Chiller cum ESP Control Room Bldg.
8.	Make-Up Water Tank for Expansion Tank	1 No.	AC per layout consideration Please refer P&ID- Annexure-10
9.	Dedicated Portable RO System (for Make-Up Water Tank for Expansion Tank)	1 No.	AC per layout consideration Please refer P&ID- Annexure-10
10.	Expansion Tank	1 No.	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.
11.	Make-Up Water Tank for condenser cooling water circuit	1 No.	AC per layout consideration Please refer P&ID- Annecure-10
12.	Condensate Storage Tank	1 X 100% (1 Working)	AC Plant room at EL. 0.0M in Chiller cum ESP Control Room Bldg.
13.	Air Handing Units / Ceiling suspended units	1 x 100 %	Inside each AHU room of respective Building.
i.	Control Room at EL. 8.50M in TG Building: • DCS Operator Room • Electronics Eqpt Room • VFD Room	1 x 100 %	AHU shall be located in AHU room at EL. 8.5M in TG Hall adjacent to Control room.
ii.	Switchgear Room at EL. 3.5M in TG Building	1 x 100 %	AHU shall be located in AHU room at EL. 3.5M in TG Hall adjacent to this switchgear room.
iii.	Switchgear Room at EL. 9.0 M in TG Building	1 x 100 %	AHU shall be located in AHU room at EL. 9.0M in TG Hall adjacent to this switchgear room.
iv	TG Hall Operating Floor (Space between EL. 8.5m to 18M)	1 x 100 %	• AHU shall be located in AHU room at EL. 8.5M in TG Hall. • Only operating floor from 8.5 to 18 m is considered for HVAC system.
v	Chiller cum ESP Control Room Bldg. : • ESP/Chiller MCC & Transformer Room at EL. 13.5M.	1 x 100 %	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 13.5M in ESP/Chiller Bldg.
vi	Chiller cum ESP Control Room Bldg. : • FGD MCC Room at EL. 21.5M.	1 x 100 %	• AHU (1x100%) based Air-cooling System. • AHU shall be located in AHU room at EL. 21.5M in ESP/Chiller Bldg.
vii	SWAS room	1 x 100 %	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
viii	Chiller cum ESP Control Room	1 x 100 %	• Ceiling Suspended AHU (Fan Coil

	Bldg. : • Chimney Control Panel Area AT EL 0.0M		Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
ix	Chiller cum ESP Control Room Bldg. : • SOx & NOx Room at EL. 0.0M	1 x 100 %	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
x	Chiller cum ESP Control Room Bldg. : • Chiller Control Room at EL. 4.5M	1 x 100 %	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
xi	Chiller cum ESP Control Room Bldg. : • ESP/FGD Control Room at EL. 4.5M	1 x 100 %	• Ceiling Suspended AHU (Fan Coil Unit) based Air-cooling System. • 1 x100% Qty • Note 2 below
14.	Fresh Air Fan Unit	1 X 100% (1 Working)	Inside dedicated AHU room of respective Building/Area.
15.	Air distribution system –Ducting (Supply and Return), dampers, and grilles/diffusers.	1 Lot	Located as per layout considerations of Air-conditioned spaces.
16.	Suitable non return isolation dampers (at the outlet of each AHU) and flexible connections.	1 Lot	Inside dedicated AHU room of respective Building/Area.
17.	Duct mounted fine filters (Inside Plenum).	1 Lot	Inside dedicated AHU room of respective Building/Area
18.	Local Control cum annunciation Panel for AHU's , Fresh Air Fan etc.	1 X 100% (1 Working)	Inside dedicated AHU room of respective Building/Area.
19.	PLC panel and microprocessor based control Panel for control & monitoring the AC equipments	1 X 100% (1 Working)	Chiller House at EL. 0.0M in Chiller cum ESP Control Room Bldg.
20.	Local control Push Button stations for all drive motors	1 Lot	Inside AC Plant (Chiller House) at EL. 0.0M in Chiller cum ESP Control Room Bldg.
21.	Chilled water piping, Fittings, Vales etc. with Insulation	1 Lot	As per Layout Consideration

22.	Cooling water piping, Fittings, Vales etc.	1 Lot	As per Layout Consideration
23.	Steam piping , condensate piping , valves with insulation	1 Lot	As per Layout Consideration
24.	Drain Piping in AC Plant Room and AHU Room	1 Lot	As per Layout Consideration
25.	Cold insulation for Chilled water piping , Chilled water pumps etc.	1 Lot	As per Layout Consideration
26.	Hot insulation for steam piping, steam condensate, steam condensate tank, condensate transfer pump etc.	1 Lot	As per Layout Consideration
27.	Thermal Insulation for Complete Supply & Return Air ducts	1 Lot	As per Layout Consideration
28.	Acoustic Insulation for Complete Supply & Return Air ducts	1 Lot	As per Layout Consideration
29.	Fire Damper	1 Lot	As per Layout Consideration
30.	Volume Control Damper	1 Lot	As per Layout Consideration
31.	Pan humidifier	1 Lot	As per Layout Consideration
32.	Heaters : Duct Mounted	1 Lot	As per Layout Consideration
33.	Power Cable	1 Lot	As per Layout Consideration
34.	Control & Signal Cable	1 Lot	As per Layout Consideration
35.	Earthing cables and strips (GI/Cu) between the bidder supplied equipment and the Purchaser Earthing grid.	1 Lot	As per Layout Consideration
36.	Cable accessories / installation materials such as jointing kits, end termination kits, Cable termination kits/plug and sockets, double compression cable glands, GI Sleeves, cable markers, cable ferrules, lugs etc.; including cable trays / GI pipes for cable laying, floor sleeves, supports, cable markers, saddles and all other associated accessories and hardware	1 Lot	As per Layout Consideration
37.	Air Curtains with fan and motor suitable for door mounting arrangement.	1 Lot	As per Layout Consideration.
38.	Instruments for AC Plant Room & AHU Room (Humidistat, temp Gauge, Thermostat, RH Gauge, Incline tune manometer, Air flow switch, Press Gauge, Press	1 Lot	As per Approved P&ID/Layout

	Transmitter, Press switch, Level Gauge, Level Transmitter, Thermowell, DPG, DPT, Pressure relief valve , 3 way valves, etc.) Refer Annexure 33 for details.		
39.	All installation and erection materials such as impulse piping, pipe fittings , tubes & tube fittings , valve manifolds, cable trays , ducts etc. for instrument installation	1 Lot	As per Approved P&ID/Layout
40.	Special tools and tackles	1 Lot	As per requirement for AC system
41.	Interconnecting Fire alarm cable from fire alarm panel (FAP) to AC system Panel (For tripping A system)	1 Lot	As per requirement for AC system
42.	Foundation / fixing nuts & bolts for all the equipments	1 Lot	As per requirement for AC system
43.	Structural steel as required for equipment support & base frame of equipments	1 Lot	As per requirement for AC system
44.	Paints along with primers and all other accessories for the complete field painting and touch up paint requirements.	1 Lot	As per requirement for AC system
45.	All the equipments , tools and tackles required for the various field test and performance test as per approved quality plan	1 Lot	As per requirement for AC system

Notes:

1. Bidder to note that the total actual cooling load mentioned above is minimum suggested total actual cooling load. Bidder shall calculate total actual cooling load of VAM systems and finalize the capacity or ton of refrigeration (TR) and correctly size all the equipment with required reserve/ capacity/ standby configuration as defined in this specification.

2. The VAM systems shall be engineered and sized such that all the components/equipment in the system shall integrate seamlessly.

3. Bidder to offer next higher rating of VAM in their product/manufacturing range, in case the final approved capacity of VAM machine is not in their manufacturing / procurement range. However, Bidder to note that any such higher rating VAM machine will be treated on par with other machines of mentioned capacity and no additional advantage will be allowed/ claimed for the same.

4. Tentative Electrical Panel wise heat load details are mentioned in Annexure-32. Bidder to consider the same for calculating the cooling load to arrive at the capacity of the VAM.

5. Suitable deration factor to be considered by bidder while calculating cooling Heat Load.

6. The capacity of the VAM may slightly increase as per the finalized architectural drawing and control room equipment layout and /or increase in the heat load of the equipment in the air conditioned space which bidder shall accommodate without any price and commercial implication to BHEL. As these details are indicative and same shall be made available to bidder during detailed engineering stage as & when the details are finalized.

7. Bidder to note that the location of the various equipment are preliminary and may change during detail engineering. Bidder, however to note that they shall not be eligible to raise any extra claim on account of any such change during detail engineering stage.

8. Exact location of FAP shall be informed during detail engineering stage.

9.3.0 Air-Conditioning System for Switchgear Room in Ammonia Storage Bldg.

9.3.1 Package air conditioners (PAC) with Air Cooled Condenser are envisaged for Switchgear Room at 4.0 m level of Ammonia storage area. The Air conditioning system shall comprise of:

- Air Cooled Package Unit ACs (Indoor & Outdoor Units)
- Fresh Air Fan Unit for AC plant Room
- Air Distribution network including Ducting, Grills/Diffusers, Insulation, filter, VCDs
- Fusible Link Type Fire Dampers
- Duct Mounted Heaters
- Pan Type Humidifiers
- Make-Up water line with valves for Humidifier.
- Instruments (Thermostat/Humidistat).

9.3.2 Dedicated and Independent AC plant room shall be located at Switchgear floor (EL. 4.5M) housing Package AC Unit of respective floor.

9.3.3 Air from the conditioned space shall be cooled by exchanging heat with the refrigerant of Package Air conditioners to maintain the specified design conditions.

9.3.4 Conditioned air from the Package Unit ACs shall enter into a common plenum with filters & shall be distributed into the conditioned space through a network of supply air ducts and Grills/Diffusers. Supply and return air Grills/Diffusers shall be installed in false ceiling. The grills/diffusers shall be adjusted suitably to have calculated amount of conditioned air in a specific area.

9.3.5 Return air shall be routed back through return air grilles into the space above false ceiling which shall act as a return air plenum and further to the respective AC plant room.

9.3.6 A Fresh Air system comprising of fan-filter arrangement located in AC Plant room shall provide fresh air from outside. Required amount of fresh air as per ISHRAE guidelines is added here.

9.3.7 Volume control dampers shall be provided in all branches of main ducts from PAC to throttle the air volume.

9.3.8 A pan type humidifier shall be located in the plant room and shall serve the humidity control requirement. Whenever the relative humidity of the conditioned space reaches the minimum allowable percentage of humidity, the humidifier shall be energized to restore the relative humidity by supplying steam to supply air on receiving signal from humidistat. The humidifier shall be such controlled that it shall not exceed the maximum allowable limit of relative humidity in the conditioned space. The humidifier shall be sized and designed accordingly. Make up water connection for Pan Humidifier shall be connected from nearest water line to suit-at-site condition.

9.3.9 A strip heater shall be located in the supply air duct to take care of the reheat control.

9.3.10 Fusible link type fire dampers shall be installed in supply air and return air path. Fire dampers shall be provided where ducts penetrate walls or floors forming fire barriers.

9.3.11 Refrigerant shall be R-407a/ R-407c/ R-410a/ R-134a or equivalent, NON-CFC and NON-ODP environmental friendly.

9.3.12 Chemical coating shall be done on heat exchange coils (condenser and evaporator coils) to avoid deterioration from saline/corrosive atmosphere.

9.3.13 Each air conditioning and air cooling system shall be interlocked with fire detection panel, so that in case of fire, the respective units are tripped automatically.

9.4.0 WALL MOUNTED SPLIT ACs

Indoor sidewall mounted type of the split air-conditioner shall be provided for areas mentioned as per clause 5.1.0 above. Unit shall directly distribute the conditioned air into the room and extract return air from the conditioned space effecting proper re-circulation.
Refrigerant for shall be R-407a/ R-407c/ R-410a/ R-134a or equivalent, NON-CFC and NON-ODP environmental friendly.

Bidder to however note that the requirements of all the variable items like copper tubing, cabling wiring etc. on the basis of finalized location of the split ACs as per site condition shall be included in bidder's scope without any additional commercial implication to the purchaser.

10.0.0 TECHNICAL DETAILS & CONSTRUCTIONAL FEATURES

10.1.0 VAPOUR ABSORPTION MACHINE (VAM)- PLEASE REFER ANNEXURE-12

10.1.1 The unit shall be double effected steam fired model duly performance tested and factory assembled with first charge of Li Br solution. The unit shall comprise, but not be limited to, the following main components. All the materials used shall be suitable for handling the corrosive solution:

i. Evaporator: Shell and tube type with process chilled water in the tubes and refrigerant water in the shell.
The refrigerant water is evaporated at very low pressure. The refrigerant shall be circulated by a canned refrigerant pump.

ii. Absorber: Shell and tube type (outer shell common with evaporator). In the shell, the concentrated Li Br solution (absorbent) absorbs the vaporised refrigerant. The cooling water from cooling tower is circulated in the tube to remove the heat of absorption.

iii. Low & High Temperature Heat Exchangers: Shell and tube type with dilute absorbent solution in the tubes and concentrated absorbent solution in the shell.

iv. High temperature Generator: Shell and tube type with steam in the tube. Dilute absorbent from absorber enters the shell and is concentrated to the required value. Refrigerant vapour released by the concentrated absorbent passes into the low temperature generator section of the shell.

v. Low Temperature Generator: The refrigerant vapour coming from high temperature generator passes through the tubes to concentrate the lithium bromide to its desired level. The referred vapours then pass on to the condenser section which is a part of the same shell.

vi. Condenser: Shell and tube type with cooling water from absorber in the tube. The shell shall be common with low temperature generator. Refrigerant vapour from generator shell enters the condenser shell and gets condensed. The tube shall be made of copper.

vii. Absorbent pump, refrigerant pump with SS impellers and vacuum pump with drive motor and all accessories.

viii. All interconnecting pipe work with necessary valves, fittings, insulation, cladding etc.

ix. Insulation along with cladding for chiller unit.

x. Control panel with all necessary instruments gauges etc.

xi. Absorbent (solution) pump with VFD for better part load efficiency.

xii. Sight glasses shall be bolted type with gaskets, safety protection shall include, but not be limited to the following:
- Thermal shock protection.
- Antifreeze protection.
- Crystallization protection (Auto-decrystalliation circuit to be provided).
- Cavitation protection of refrigerant pump.
- Absorbent pump thermal cutout (ATHC).

xiii. Alarm sequences shall be included, but not be limited to the following:
- Dilution cycle alarm sequence.
- Total shutdown alarm sequence.
- Power failure alarm sequence.

xiv. Steam control valve at inlet of chiller.

10.1.2 The machine shall be complete with all related piping, solution and refrigerant pumps, heat exchangers, purging system, pre-wired control panel with all instruments, pneumatic tubing, cables, valves, inter locking safeties & controls, relays, auxiliary relays, temperature and pressure monitoring equipment, measuring system for the important performance parameters such as steam consumption, cooling water flow rate with in/ out temperatures, chilled water

flow rate with in/ out temperatures, condensate temperature etc. and annunciation panel. The machine shall be suitable for fully automatic operation down to 10% turndown capacity.

10.1.3 All accessories & materials for erection installation, operation and safety of the equipment including service platform with ladder for operation / servicing / checking of readings on instruments, as required for VAM, shall be included in bidder's scope.

10.1.4 Tube materials shall be 90/10 Cu/Ni for all vessels, except for generator which shall be of Stainless Steel SS-316.

10.1.5 Isolating valves shall be provided on both sides of refrigerant and solution pumps so that these pumps can be taken out at site for maintenance without loss of vacuum in the machine.

10.1.6 Hot fluid in-rush on start-up of machine shall be maximum 120% of full load requirement.

10.1.7 The exchangers of VAMs shall be selected for following fouling factors.

- 0.0002 m2 hr. oC/kcal for chilled water side of chiller/evaporator.
- 0.0004 m2 hr. oC/kcal for cooling water side of condenser/adsorber.
- 0.0001 m2 hr. oC/kcal for steam side.

10.1.8 All the shells of VAMs shall be made of Boiler Quality Plates.

10.1.9 The Vapour Absorption Refrigeration Plant shall be complete in all respects, capable of unattended operation. Control system shall be provided for automatic capacity control, and smooth/efficient performance of plant.

10.1.10 Condensate tanks shall be fabricated from carbon steel plates (ASTM A36). Tanks shall be of adequate size. Tank wall thickness shall be atleast 6 mm. Carbon steel piping network with fittings to collect condensate from AHU and discharge to nearest rainwater shaft/ drain outside the building at grade level. Condensate line shall have water seal arrangement and fully insulated.

10.1.11 Refrigerant shall be DM water

10.1.12 Please refer Annexure-12 for detailed description of VAM.

10.2.0 Air Cooled Package AC

10.2.1 Air cooled type Package AC Units shall comprise of scroll/screw compressors with motor, drive package with guard, Air cooled condenser with condenser fans, interconnected insulated refrigerant piping complete with necessary fittings, DX evaporator coil, control and line accessories, Panel, first charge of refrigerant and oil.

10.2.2 The Evaporator coil shall be of direct expansion type and constructed with copper tube and aluminium rippled type fins mechanically bonded for maximum heat transfer.

10.2.3 The compressor shall be scroll type suitably mounted on vibration isolator to minimize vibration transmitted to the AC unit as per manufacturer standard.

10.2.4 Safety devices for high inlet and low outlet pressure and other standard accessories shall be provided as per manufacturer standard.

10.2.5 The heat exchangers shall be designed for a minimum design test pressure of 21.0 Kg/m2 on the refrigerant side and shall conform to the latest ASME CODE for unfired pressure vessels Section - VIII.

10.2.6 Chemical coating shall be done on heat exchange coils (condenser and evaporator coils) to avoid deterioration from saline/corrosive atmosphere.

10.2.7 Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating. The supports shall be as per TEMA Standard.

10.2.8 Drain line shall be connected to the nearest surface drain.

10.2.9 Refrigerant for shall be R-407a/ R-407c/ R-410a/ R-134a or equivalent, NON-CFC and NON-ODP environmental friendly.

10.2.10 Please refer Annexure-13 for details.

10.3.0 Split Type Air-Conditioning Unit (Non ducted)

10.3.1 The split type room air conditioner consists of two units, one Indoor unit (Evaporator) & an Outdoor unit (Condenser). It will be complete with all components to perform filtering and cooling of air in all seasons except winter. The refrigerant condenser will be air-cooled. The unit will be suitable for wall mounting.

10.3.2 Split AC Units shall be energy efficient with minimum 3 star rating approved by BEE (Bureau of Energy Efficiency).

10.3.3 Indoor unit consisting of direct expansion cooling and dehumidifying coil, Blower, insulated drain pan, coarse filter panel, casing of aesthetically designed ABS molded plastic construction for direct mounting unit as per manufacturer standard.

10.3.4 Outdoor unit consisting of hermetic / semi-hermetic scroll compressor, on anti-vibration mounts, axial flow fan air cooled condenser of seamless copper with aluminium fins, design & construction. Casing of galvanised sheet metal weather proofed or stored enameled against corrosion as per manufacturer standard.

10.4.0 PUMPS (Please refer Annexure-12)

10.4.1 All rotating equipment & drivers (including gear units and couplings if any) shall be designed to perform satisfactorily under specified start up conditions, part load operation, maximum differential pressure operation and relief valve set pressure and up to full speed/maximum continuous speed.

10.4.2 The equipment supplier shall be one from the approved list of vendors provided elsewhere in the bid package.

10.4.3 All Rotating equipment package shall be complete with drivers, auxiliary systems, instrumentation and control systems, and necessary electrical / safety devices as applicable or required. Any other hardware as required over and above that specified for safe and satisfactory

operation of the rotating equipment shall also be established and supplied as part of the package.

~~**10.4.4** Motors, electrical/instrument components and electrical/instrument installations shall be suitable for the area classification.~~

10.4.5 All equipment shall be either directly driven or driven through gear box. V-Belt drive arrangement may be provided, where it is permitted by the applicable basic.

10.4.6 All critical equipment intended to be mounted directly on foundation, without base plate and having flat mounted surface shall be grouted using epoxy grouting or as recommended by pump manufacturer.

10.4.7 Chilled Water Pumps

Chilled water pumps shall be horizontally split casing type. Pump casing shall be of close grained, high tensile cast iron. Impeller shall be of bronze with high tensile steel shaft. The pump speed shall be preferably less than 1500 RPM. The pumps shall be directly coupled to drive through flexible coupling. The pumps shall be complete with electric motor, common base frame, insulation etc. The impellers shall be statically and dynamically balanced. The bearing shall be of antifriction type.

10.4.8 Condenser (Cooling) Water Pumps

Cooling water pumps shall be horizontally split casing type. Pump casing shall be of close grained, high tensile cast iron. Impeller shall be of bronze with high tensile steel shaft. The pump speed shall be preferably less than 1500 RPM. The pumps shall be directly coupled to drive through flexible coupling. The pumps shall be complete with electric motor, common base frame etc. The impellers shall be statically and dynamically balanced. The bearing shall be of anti-friction type.

10.4.9 Condensate water transfer Pumps

The pumps shall be of mono-block type.

10.4.10 Please refer Annexure-12 for detailed description of Pump.

10.5.0 MAKE-UP WATER TANK / EXPANSION TANK

Storage tank shall be used either for storage of water/brine or as a buffer tank. Storage tank shall be fabricated from 6 mm thick carbon steel plate in welded construction for 8 hours holding capacity with inlet , outlet , makeup , quick fill , overflow , drain connection & level gauge. Insulation shall be finished with 24 gauge SS chicken wire mesh & 1:3 cement sand plaster in two layers of 6 mm each.

10.6.0 AIR HANDLING UNIT

10.6.1 The air-handling unit shall be of double skin, with insulation in sectionalized construction for convenient transportation and installation. The air handling unit shall comprise of filter section, damper section, heating section (if required), humidifier section (if required), cooling coil section, fan section and drain pan.

10.6.2 Damper section shall have face & bypass damper. Bypass area shall not be less than 1/4th of the face area.

10.6.3 Fan section shall be made out of 1.6 mm thick MS sheets with adequate stiffeners and support channel base and shall have drainage provision. Fan section inside shall be insulated with 50 mm thick TF quality thermocole. The fan shall be of centrifugal, double inlet double width (DIDW) design with forward curved impeller. The fans shall be provided with V-belt and pulley drive. The fan shall develop sufficient static pressure to meet the system requirements. Testing of fan shall be done as per AMCA / IS codes. The motor shall be positioned in such a way that the slack side of the best is at the top. The fan and motor shall have common channel-base mounted on AHU channel base with suitable vibration isolator.

10.6.4 Flame resistant canvas connection with metallic flanges shall be provided between fan outlet & duct.

10.6.5 Two layers of filters shall be used. The first layer used as pre-filter shall be polyethylene fibre panel type air filters with an efficiency rating of 90% down to 20 microns dust particles size. The second layer of filter shall be of fabric panel type with an efficiency rating of 90% (min.) down to particle size of 5 microns. The face velocity shall not exceed 2.5 m/s. Wherever the AHU room has a 'Fresh air system' with pre-filters in filter frames provided on the exterior walls, pre-filters need not be provided in the AHU. Manometer across fine filters, one pressure switch and pilot light on panel to indicate dirty condition of filter to be provided.

10.6.6 Air velocity through the coil shall be 2.5 m/s maximum. Water velocity through the coil shall be between 0.6 m/s and 1.8 m/s.

10.6.7 The head-capacity characteristic of the Fan shall rise continuously from the maximum capacity to surge. The Fan shall, without the use of a bypass, be suitable for stable operation at all capacities higher than the surge capacity shown. All characteristic curves shall be corrected for specified process gas and shall refer to the capacity at the normal intake conditions specified on the data sheets.

10.6.8 Centrifugal fans shall be mechanically designed for a temperature at least 15°C beyond the extreme temperature anticipated for the specified operating conditions.

10.6.9 A drain connection with block valve and blind flange shall be provided at the lowest point of the casing and inlet box(es).

10.6.10 The casing construction shall have provision (Manways/Removable panels) to allow inspection and cleaning of impeller and casing internals.

10.6.11 Please refer Annexure-12 for detailed description of AHU and Motor.

10.7.0 HEATING UNIT

10.7.1 Heating shall be preheating and/or reheating as per psychometric process requirement.

10.7.2 Electric strip heaters shall be complete with- heating thermostats/humidistat, safety thermostats and contactors. Hot water/steam coils- shall be complete -with control valve, humidistat/thermostat etc.

10.7.3 Reheating of air shall be provided to correct Relative Humidity in monsoon/winter heating. Heating shall be electric type. Electric heaters shall be provided inside the duct/plenum in properly distributed number of banks.

10.8.0 HUMIDIFIER UNIT

10.8.1 Pan humidifier shall be complete with immersion type electric heaters actuated by humidistat, water float valve, stop valve in water make up line, level switch interlocked with heaters. Pan shall be fabricated with 3 mm carbon steel sheets and 25x25x3 nun angle on edges with class C socket end connection. The outer surface shall be- thermally insulated.

10.8.2 Water spray type humidifier shall comprise of spray header, nozzles, arms etc; fractional h.p. pump set, humidistat, solenoid valve etc. Make up tank, water collecting trough complete with drain, quick fill, overflow, strainer, make up connection with ball & float valve and isolating valves shall be provided.

10.8.3 Drain pan/water collecting trough of water spray humidifier shall be of stainless steel construction and thermally insulated.

10.8.4 The humidifier shall be sized to deliver 110% of capacity required.

10.8.5 Pan type humidifier of stainless steel construction shall be provided to meet specified humidity requirement in winter season.

10.9.0 AIR FILTERS

10.9.1 Please refer Annexure-12 for detailed description.

10.10.0 DUCTING AND OTHER LOW SIDE ITEMS

10.10.1 DUCTING

All duct work inclusive of accessories such as damper, vanes, access doors, etc. shall be manufactured form hot-dip galvanized sheet metal, complying with IS-277 Gr. 120 of zinc coating. Duct shall be designed and fabricated as per IS-655.

Following air velocities shall be considered for air conditioning:

Louvers for Air Inlet	2m/s max.
Main Ducts	8-9 m/s (max.)
Branch Duct	5-6 m/s (max.)
Supply Grills/Diffusers (Neck Velocity)	3-4 m/s (max.)

Note:

- Duct velocity may be increased at certain sections to meet layout constraints. However, the overall efficiency and noise level shall be maintained within acceptable limits.

Duct work shall be suitably supported by duct hangers and anchor fasteners in roof. 6mm thick neoprene gasket shall be provided between all flange joints. All joints shall be made air tight with sealant. Leak test shall be conducted on duct before installation.

Duct work shall be provided with following accessories (as applicable):

- Volume control damper (opposed blade type with 16G 150mm wide blades and 14G casing of GSS.
- Rubber impregnated fire resistant canvass connection between duct and AHU/PAC outlet.
- Access door for Heaters, Fire Dampers, filters.

10.10.2 Supply and Exhaust Air Grilles / Diffusers

Each supply air diffusers shall be fitted with opposed blade damper, built-in vanes and louvers arranged as per manufacturer's standard design.

All return air grill/diffusers shall be without volume control damper. All grilles / diffusers shall be fitted with suitable gasket to prevent air leakage

Please refer Annexure-12 for detailed description.

10.10.3 Fire Damper

Fusible Link Type Fire dampers shall be provided in accordance with the relevant codes of the National Fire Protection Association (NFPA) or equivalent. Damper frame and blades shall be galvanized.

Please refer Annexure-12 for detailed description.

10.11.0 EXPANSION TANK (FOR CHILLED WATER SYSTEM ONLY)

i. Expansion tank shall be provided by vendor and installed at-least 1 m above the highest point of the system.

ii. Tank shall be of minimum 500 liter capacity (unless otherwise required because of system design requirement) fabricated from 10G thickness of SS304 material.

iii. The tank shall be complete with float valve assembly backed up with Gate valve for makeup, quick fill gate valve, drain with valve and overflow.

iv. Tank shall have rigid supporting arrangement of structural steel per IS-2062/ASTM A36.

10.12.0 INSULATION (PLEASE REFER ANNEXURE-10)

10.12.1 HOT INSULATION

i. Bare surfaces of pipe/equipment shall be provided with one coat of 20 micron min. (dry film thickness) heat resistant primer up to 125 deg. C operating temperature.

ii. Resin bonded mineral wool conforming to IS-8183 shall be used for hot insulation. Preformed pipe sections/mattresses of min. density 120 kg/m3 shall be used. The minimum thickness of insulation shall be as per table for insulation material and thickness mentioned below.

iii. Hot insulation shall be cladded with 26 SWG aluminium sheeting and 24 SWG aluminum sheeting above 14" dia. pipes, equipment.

iv. Please refer Annexure-10 for detailed description.

10.12.2 COLD INSULATION

i. Supply air duct shall be provided with 50 mm thick resin bonded glass wool having density of 24 kg/m3 covered with 0.3 mm GI sheet.

ii. Return air duct (if applicable) shall be provided with 25 mm thick resin bonded glass wool having density of 24 kg/m3 covered with 0.3 mm GI sheet.

iii. Any portion of the supply/return duct running outside the building shall be insulated with 50 mm thick expanded polystyrene. The insulation shall be given weather proofing of 20 mm thick sand cement plaster.

iv. Supply and return of chilled water pipe and drain pipes within battery limits shall be insulated with Polyurethane foam. Aluminium cladding shall be provided for supply & return chilled water pipe over insulation. The thickness of claddings shall be as follows:

- Pipe Size 150NB & Below – 0.711 mm
- 150NB < Pipe Size < 450 NB : 0.914 mm
- 450 NB < Pipe Size : 1.219 mm

v. Sound Attenuators shall be installed in ducts, as required.

vi. Please refer Annexure-10 for detailed description.

10.12.3 ACOUSTIC INSULATION

Duct acoustic insulation shall be provided on the inner surface of ducting for a minimum distance of 6 M from AHU/Package AC unit Outlet. The acoustic insulation shall be resin bonded glass/mineral wool with density not below 48 kg/m3 & thickness of the same shall be 12 mm, Cladding to be provided over insulation using Al sheet 30 G.

Please refer Annexure-12 for detailed description.

10.13.0 COOLING TOWER

Cooling tower casing shall be of FRP construction with an axial flow fan mounted on top. Water basin shall be of FRP construction with a cylindrical auxiliary suction tank at the bottom. Drain shall be provided to facilitate easy removal of dust from the bottom of the tank.
Supporting structure and framework for tower casing and water basin shall be made of galvanised steel and finished with epoxy painting.
Sprinklers shall be corrosion-proof and abrasion resistant, the sprinkler head shall be made of aluminium alloy and fitted with sealed ball bearings. Fan shall be of axial flow type and aluminium alloy material.
The fan shall be designed for delivering large air volume at high efficiencies and low noise levels, the cooling tower shall be complete with all pipework.

Please refer Annexure-12 for detailed description.

10.14.0 WATER PIPING

Please refer attached Annexure-17 for PMS

10.14.1 INDIAN BOILER REGULATIONS (IBR)

Steam lines with conditions listed below fall in the scope of IBR.

a. Lines having design pressure (max. working pressure) above 3.5 Kg/cm2 (g).
b. Line sizes above 10" inside diameter having design pressure 1.0 Kg/cm2(g) & above.
c. Lines with design pressure less than 1.0 Kg/cm2(g) are excluded.
d. Users of steam like steam tracing lines, jacket of the steam jacketed lines, steam heating coil within the equipment are excluded from IBR scope.

10.14.2 IBR REQUIREMENTS (IN BRIEF)

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i. All materials used on lines falling under IBR must be accompanied with IBR Inspection Certificate in original.
ii. Alternatively, photocopy of the original certificate duly countersigned and attested by local boiler inspector is acceptable.
iii. For Indian supply only IBR is the inspection authority.
iv. IBR documents as per IBR requirement for lines falling under IBR must be approved by IBR authority of State in which the system is being installed.
v. All welders used for fabrication of IBR system must possess IBR welding qualification certificate.
vi. IBR system shall be designed to comply with IBR regulations as well as ASME B31.3. Design calculations for the same must be approved by IBR authority.
vii. IBR approval is obtained with requisite fees payable to Indian Boiler Board of the State concerned. The same shall be included in bidder's scope.
viii. Steam generators (boilers/heat exchangers) shall require exclusive IBR approval along with it's integral piping upto the final isolation valve.
ix. The discretion of IBR authority of state is final and binding for the above cases.

10.14.3 STEAM LINES

i. Branch lines from horizontal steam header, except condensate collection points, shall be connected to the top of the pipe header.
ii. All branch lines shall be drainable.
iii. Drip legs & steam traps shall be provided at all low points and dead ends of steam header. Drip legs at low points shall be closer to downstream riser and shall be provided to suit bi-directional flows, if applicable.
iv. All traps shall be provided with strainers if integral strainers are not provided.
v. Expansion loops are to be provided to take care of the expansions within units
vi. Wherever condensate is to be drained, proper condensate draining facility shall be provided.

10.15.0 MATERIAL OF CONTSTRUCTION (MOC) OF MAJOR ITEMS:

Sl No	Item	MOC	Remarks
1.	All piping	Make up water : MS ERW as per IS 1239 Part-1 (Med. grade) MP steam : A 106 Gr. B As per ASME B36.10 Condensate Water : A 106 Gr. B As per ASME B36.10 Instrument Air: MS ERW Galv. as per IS 1239 Part-1 (Med. grade) Cooling water MS ERW as per IS 1239 Part-1 (Med. grade)-up 150NB Cooling water MS ERW as per IS 3589 (Fe 410Mpa) – above 150 NB Chilled water: MS ERW as per IS 1239 Part-1 (Med. grade)- up 150NB. Chilled water MS ERW as per IS 3589 (Fe 410Mpa) – above 150 NB	Contract Technical Specification for Pipework as per Contract clause 4.0 of Section-IIC.
2.	Thermal Insulation : Supply Air Duct	50 mm thick resin bonded glass wool having density of 24 kg/m3 with aluminium foil lamination covered with 0.3mm GI sheet	Contract Technical Specification for Air-Conditioning. Clause 5.8.2 of Section-VIII.
3.	Thermal Insulation : Return Air Duct	25 mm thick resin bonded glass wool having density of 24 kg/m3	Contract Technical Specification for Air-

		with aluminium foil lamination covered with 0.3mm GI sheet	Conditioning. Clause 5.8.2 of Section-VIII.
4.	Acoustic Insulation	Resin bonded glass/mineral wool of density 48 kg/m3 & thickness 12 mm, Cladding with 30G perforated Al sheet.	Contract Technical Specification for Air-Conditioning. Clause 5.8.2 of Section-VIII.
5a	Insulation (Cold): a. Refrigerant Piping	Polyurethane Foam (PUF) insulation as per OEM Stand.	Alu cladding on Supply & return chilled water piping to be provided as mentioned above.
5b	Condensate drain piping	Polyurethane Foam (PUF) insulation , Density 35-40 Kg/m3 , 15mm thick.	
5c	c. Chilled water piping fittings etc	Polyurethane Foam (PUF) insulation , Density 35-40 Kg/m3 , 40mm thick.	
5.	Insulation (hot):	Resin bonded mineral wool , density 140 Kg /m3 (for Pipe) & 128 Kg /m3 (for Slab). • as per IS 8183 for pipe size above 350NB • as per IS 9852 for pipe size upt 150NB.	
6.	Pan Humidifier	SS Construction	
7.	Duct	Galvanized Steel sheet : Grade 120 as per IS 277	
8.	AHU	Double skinned AHU (50 mm PUF insulated) Outer sheet: 1.6mm MS sheet.	
9.	Condensate Storage Tanks	MS tank with insulation	
10.	Chilled water pumps	Casing: Cast Iron ASTM A159 Shaft: SS304 Impeller: Cast Bronze ASTM B 584	
11.	Cooling water pumps	Casing: Cast Iron ASTM A159 Shaft: SS304 Impeller: Cast Bronze ASTM B 584	
12.	Condensate transfer pump	Casing: SS 304 Shaft: SS304 Impeller: SS 304	
13.	Supply diffusers	Anodized aluminum	
14.	Return air grilles	Anodized aluminum	
15.	Expansion Tank	MS Construction with insulation	

10.16.0 GENERAL ELECTRICAL GUIDELINES

Please refer attached Annexure-15.

10.17.0 CONTROL & INSTRUMENTATION

10.17.1 Standard Specification for Instruments: Please refer attached Annexure-14.

10.17.2 Instruments Datasheet: Please refer attached Annexure-33.

10.17.3 Instruments Standard Installation: Shall be furnished after award of contract.

10.17.4 The following Control Panel / annunciation panels shall be envisaged for the AC system :

i. One PLC based control panel for the Centralized AC system
ii. One VAM skid mounted microprocessor based panel for VAM
iii. One Local push button cum annunciation panel in each AHU room for AHU's and other AC Equipments

10.17.5 Control philosophy:

i. The Operation & Control of the VAM unit shall be from integral PLC/ Microprocessor based control system as per manufacturer standard. The PLC/ Microprocessor based integral control system will be interfaced with the overall PLC system envisaged separately for control and operation of Air conditioning Plant.

ii. Operation and monitoring of the following centralized AC system equipment shall be done from the control panel located in the AC plant room:
- VAM –Monitoring only
- Condensate pumps shall be interlocked with the condensate levels in the tank. The pumps shall be AUTO mode i.e. on failure of one pump, second pump shall start automatically.
- Chilled and cooling water pump– Manual operation & Monitoring
- FRP Cooling tower motor– Manual operation & Monitoring
- AHU – Remote Operation & Monitoring
- ~~Fire Damper – Monitoring & reset~~
- Humidistat , Thermostat & Three way operating valve – Monitoring
- Chilled water inlet & outlet pressure , temperature – Monitoring
- Cooling water inlet & outlet pressure , temperature – Monitoring
- Condensate water pressure , temperature – Monitoring
- Steam pressure & temperature monitoring

iii. Local control cum annunciation panel for the AHU: Manual operation and monitoring of the centrifugal fans, Pan Humidifier, Heaters, Fresh air units.

~~iv. Potential free contacts for operation of the fire dampers shall be provided in the AHU control panel, for actuation of fire damper on receipt of fire signal from the Fire Alarm Panel.~~

v. Running and trip status of the following equipments shall be made available in the plant DCS by means of potential free contacts

a) VAM (from AC Panel in the AC plant room)

~~b) Fire damper (open / close indication from AHU Panel)~~

10.17.6 Temperature & Humidity Control in the Air Conditioned Space:

i. Room temperature control shall be achieved with the help of modulating 3-way chilled water flow regulating valve of AHU. The 3 way modulating valve will be actuated by the thermostat located in the return air duct .

ii. Room RH shall be controlled with duct mounted humidifiers & strip-heaters. The Pan humidifier & strip heaters will be actuated respectively by humidistat and thermostat in the return air path.

10.17.7 Bidder shall include all controls & instruments as required for safety & operational requirements of the complete AC plant.

10.17.8 Automatic operation of all controls wherever feasible is required, with manual overdrive for maintenance etc.

10.17.9 All controls shall be suitably interlocked for safe & sequential operation of plant generally in the following order:

a) Start AHU blower.
b) Start Cooling water pump.
C) Cooling Tower
d) Start water pump.
e) Start chiller/VAM unit

While shutting down the plant, equipment will stop in the reverse order as listed above.

10.17.10 Controls, Instruments and safety devices required for smooth and unattended operation of equipment/plants.

10.17.11 Monsoon reheating package shall be actuated by humidistat and winter- heating banks by thermisters control. These shall operate only on running of AHU blower.

10.17.12 Humidifier heaters shall be actuated by humidistat.

10.17.13 Potential free contact shall be provided by bidder for ~~closing motorized fire dampers and simultaneously~~ tripping the AHU blower motor on receiving the fire signal from purchaser's Fire Alarm Panel. ~~On expiry of fire signal, fire dampers shall open manually through reset button.~~

10.17.14 VAM control system shall be microprocessor based programmable control system dedicated for each VAR machine. The control system shall be complete in all respect to execute all interlocks and controls for safe and efficient operation of a VAM machine.

10.17.15 The Vapour Absorption Refrigeration system shall be complete in all respects, capable of unattended operation. Control system shall be provided for automatic capacity control, protection of VAM including anti-crystallization and antifreeze protection and smooth/efficient performance of plant.

10.17.16 Controls & Instrument section of the VAM panel shall consist of minimum following safety features;-

i) Low chilled water temperature - alarm.
ii) Antifreeze - trip.
iii) Low chilled water flow - alarm.
iv) Low condenser cooling water flow - alarm.
v) Low water level in humidifier tank·- alarm & trip.
vi) Air Heater change over switch.
vii) Selector switches for pumps.
viii) Air Flow Switch - alarm.
ix) Overload protection for all motor.

10.17.17 The VAM Control panel shall contain at-least the following control for the automatic operation of chilling unit.

i) capacity control device.
ii) Start/stop push button station for the machine.
iii) Automatic temperature controller chiller water temperature.
Chiller water temperature controller shall be of PID type.
iv) Start / stop push button station for chilled water pump set.
v) Operation indicating pilot lamps.

10.17.18 The VAM Control panel shall contain at-least the following fault annunciators

a) Low chilled water pressure
b) Low chilled water flow.
c) Low condenser cooling water flow.
d) Low chilled water temperature
e) Low evaporator pressure.
f) High condenser pressure.
h) Low water level in humidifier tank.
i) Chilled water pump motor over load.
j) Condenser cooling, water pump, motor over load.
k) Air handling unit motor overload.
m) Treated water pump motors overload (in case water softening plant is furnished).
o) Open/close position of fire/smoke dampers.
p) Fresh Air fan status.
q) Any other as necessary

10.17.19 In the event of a fault, the particular window shall glow and the window will remain lighted till the fault is rectified.

10.17.20 Minimum 20% spare windows shall be provided on annunciator.

10.17.21 Vapour Absorption Refrigeration system shall monitor and control the following as a minimum:

i) Chilled water in & out temperature
ii) Chilled water in & out pressure
i) Cooling water in & out temperature
ii) Cooling water in & out pressure
iii) Steam in temp. and pressure
iv) Condensate out temp. & pressure
v) Total hours of operation of machine
vi) No. of machine's refrigerant pump shut-offs
vii) No. of machine's shut-offs
viii) Log of all critical parameters on hourly basis
ix) PC connectivity.
x) Percentage of steam control valve opening(position transmitter to be included in the base price).

10.17.22 A globe valve with actuator/controls shall be provided in cooling water and chilled water circuit to close automatically/manually, whenever flow of cooling water and chilled water stops.

10.17.23 One number of Local Control cum Annunciation Panel for each AHU rooms for AHU shall be in bidder's scope.

10.17.24 For AHU System the panel shall have annunciation pertaining to TRIP, START, STOP of AHU and START , STOP of ~~fire damper~~, pan humidifier, heater

10.17.25 These shall be fed directly by MCC Panel. This MCC panel shall be supplied by others. The DOL starter and all other logics shall be located in this MCC Panel.

10.17.26 AHU, pan humidifier, heater are envisaged to be started & stopped locally from the bidder's supplied Local Control cum Annunciation Panel.

10.17.27 The AHU control cum annunciation panel shall have provision of repetition of control and monitoring of all the equipments in the AHU plant room in the main PLC based control panel (also included in bidder's scope). Supply and erection of all the necessary cabling and erection hardware's for the same shall be included in bidder's scope.

Control Cum Annunciation Panel in AHU Room

INDICATION		CONTROL
AHU	ON	ON PUSH BUTTON
	OFF	OFF PUSH BUTTON
	TRIP	
Pan Humidifier	ON	ON PUSH BUTTON
	OFF	OFF PUSH BUTTON
Heater	ON	ON PUSH BUTTON
	OFF	OFF PUSH BUTTON
AC	Healthy	
	Unhealthy	
Ammeter		
Voltmeter		

AUTO/MANUAL SWITCH

LOCAL/REMOTE SWITCH

~~**10.17.28** Motorised fire damper shall be actuated on receipt of fire signal from Fire alarm Panel (FAP) shall be supplied by others.~~

~~**10.17.29** On receipt of fire signal, through potential free contact in the bidders supplied equipment from FAP , a control circuit will be energized in the MCC panel to feed this fire damper motor.~~

~~**10.17.30** The feedback signal (run / stop) will also be made available in this Local Control cum Annunciation Panel from MCC.~~

~~**10.17.31** Normally the fire damper shall operate in auto mode on receipt of signal from DGFAP. However, provision for manual operation from this panel and FAP shall also be provided in the bidder's supplied panel. All the necessary logics / interlocks for this shall be envisaged in the bidders supplied panel.~~

~~**10.17.32** Provision for auto (from FAP) / manual (remote and local both) opetration of the fire damper shall be be provided in the Local Control cum Annunciation Panel . Necessary selector switch to realize this feature shall be provided by the bidder in this panel.~~

10.17.33 Supply and erection of Control wiring from FAP to the bidder's panel is included in bidder's scope. All control wiring from the bidder's supplied panel to the bidder's supplied equipments shall be in bidder's scope.

10.17.34 Termination kit at the Local Control cum Annunciation Panel shall however be included in bidders scope.

10.17.35 On pressing the start / stop push button in this panel, a control circuit will be energized in the MCC Panel and power supply be made available / stopped at the motor terminals. Further the feedback signal (run / stop / trip) will also be made available in this Local Control cum Annunciation Panel from MCC.

10.17.36 All the above control wiring from annunciation cum control panel terminal to MCC is excluded form bidder's scope .Termination kit at the Local Control cum Annunciation Panel shall however be included in bidder's scope.

10.18.0 PROGRAMMABLE LOGIC CONTROLLER (PLC)

10.18.1 Programmable logic controllers shall be well proven and shall have robust standard configuration as specified below:

- The system (with all its sub-systems) as being offered / supplied should have been installed and operating satisfactorily in a similar Unit application of hydrocarbon industry like Refinery, Petrochemical or Gas Processing Plant for *at least 4000 hours* (as collaborated by user certificate).
- The system should be supplied, engineered, integrated, tested etc. from a factory from where the system / sub-systems as offered / supplied have already been supplied, engineered, integrated, tested etc. and meet the criteria 2.1 above.
- All the activities including engineering should be carried out by the agency which have carried out the similar activity in the past and meets the criteria 2.1 above.
- The system should be supplied by the manufacturer in the fully engineered condition or should be supplied by the manufacturer's representative / subsidiary who have proper infrastructural facilities and meets the criteria 2.1 above.
- In any case, the manufacturer whose system is being offered / supplied should have a local representation / subsidiary which have the proper infrastructural facilities like engineering, installation, maintenance, testing, spare part support, system fault diagnosis and other related logistic support. Systems, which don't have the local base, should be avoided.

10.18.2 Scope Matrix for Supply, Engg and Installation & commissioning of VAM PLC

S.No.	Description	Engineering by	Supply by	Erection by	Commissioning by	Remarks
[A]	**VAM PLC** including, operation station, Engineering station, software and other items, etc.	Bidder (Note-3)	Bidder	Bidder	Bidder	Note-(4)

Notes:

1) Termination accessories and termination of all types of cables at bidder supplied items/panels shall be in Bidder scope.

2) Engineering of Panels, model selections, configuration of software, etc are part of Bidder scope.

3) Any special activities involved in erection like FO cable splicing, termination, etc. shall be by bidder including special tools & tackles.

4) PLC I/O List, Signal grouping, Logic diagrams & inputs for graphics shall be provided by bidder after P.O. placement.

10.18.3 Please refer Annexure-34 for VAM PLC technical specification along with Annexure-14 for C&I details.

11.0.0 PAINTING SPECIFICATION

Please refer attached Annexure-18.

12.0.0 ERECTION GUIDELINES

12.1.0 Erection & commissioning of all the items / equipments supplied by bidder is included in bidder's scope.

12.2.0 Bidder to note that the fronts for erection & commissioning activity of the Air-Conditioning system shall be made available to the bidder, as & when available and ready at site. Bidder shall plan his E&C activities accordingly.

12.3.0 Bidder to take cognizance of the fact that the E&C activities of Air Conditioning system, being dependent on the progress of the erection of other agencies at site, may get delayed due non availability of fronts etc. due to reasons beyond purchaser's control. Bidder to note that will not be entitled to raise any extra claim on account of these delays. All the cost of any eventual delay in the E&C of the Air conditioning system shall be deemed to be included in the price quoted by the bidder.

12.4.0 COMMISSIONING & PRE-COMMISSIONING ACTIVITIES:

12.4.1 The bidder shall be responsible to carry out pre-commissioning, commissioning and performance test run of Air conditioning system with Purchasers, PMC and End Customer's operating personnel.

12.4.2 A procedure for detailed mechanical completion, pre-commissioning, start-up and performance test shall be developed by the bidder based on the guideline furnished elsewhere and this shall be approved by Purchaser, PMC and end customer.

12.4.3 Bidder shall also submit operation manual.

12.4.4 Bidder shall submit the pre-commissioning and commissioning schedule in the form of network detailing therein the sequence of all the pre-commissioning and commissioning activities and time taken by each individual activity to be carried out in each equipment / sub-system of the units. This shall be submitted to Purchaser prior to start of pre-commissioning activities.

12.4.5 Bidder shall submit weekly progress report and the status of pre-commissioning and commissioning activities, likely slippage and action being taken by the bidder to contain this slippage.

12.5.0 MECHANICAL COMPLETION

12.5.1 Bidder shall declare mechanical completion after all installation works of the system have been completed and hydro tested in accordance with approved construction drawings, approved specification, applicable code as defined in the document, accepted international good engineering practices and all the activities have been completed in a comprehensive manner by the bidder.

12.5.2 After Mechanical Completion of systems bidder shall check the system/sub-system so that system/unit/system/sub-system meets the process requirement and is constructed as per the approved drawings.

12.5.3 After liquidating the checklist bidder shall submit certificate as per FORMAT-I (attached in Annexure-xx) stating system/sub-system, which is mechanically completed.

12.5.4 Checklist generated by bidder and test certificates connected with the system/sub-system will form a part of the FORMAT-I. Certificates of various statutory bodies for relevant portion of the work completed shall be made available by the bidder as part of mechanical completion.

12.6.0 PRE –COMMISSIONING ACTIVITIES

12.6.1 Bidder shall raise FORMAT – III (as per format given in Annexure-26) which certifies that all checklist points are liquidated and the system/unit /system/sub-system is ready for pre-commissioning.

12.6.2 Bidder will start pre-commissioning activities after acceptance of FORMAT-III by Purchaser /PMC/End customer. This shall include but shall not be limited to activities such as system checking

i. As per P&IDs/Drawings, site modifications, internal inspection of equipment/vessels, flushing/steam blowing, air blowing of pipelines including gasket blowing, purging of system using inert gas, leak test both for low pressure systems, lube oil circuits, calibration of instruments,
ii. checking of the electrical equipment for proper earthing, continuity, insulation resistance,
iii. Conducting operability test on individual equipment/system, charging of lubes & other chemicals.

iv. Fabrication and supply of temporary facilities, for example, temporary bypasses, spools, blinds,

v. jump overs, vents, strainers, screens etc. which will be required to carry out pre-commissioning activities

12.6.3 The following checklist represents the absolute minimum work, which has to be performed by the bidder prior to commissioning
This, however, it is not intended to be a complete list of activities required to be carried out by the bidder. Manufacturer's/Sub-Vendor's instructions for pre-commissioning checks, testing must also be followed for all equipment.

i. Installation of Seals and Packing

- Install mechanical seals, permanent packing and accessories, wherever required.
- Adjust and replace mechanical seals, packing and accessories, as necessary during pre-commissioning / commissioning period.

ii. Removal of Temporary Bracing

- Remove all temporary supports, bracing, or other foreign objects that were installed in vessels, transformers, piping, rotating machinery or other equipment to prevent damage during shipping, storage and erection.

iii. Rotation and Alignment

- Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver
- Make cold alignment to the manufacturer's tolerances along with Purchaser/ PMC/ End customer. Provide all the alignment readings records to Purchaser/ PMC/ End customer
- Check all lubricants and their quality, fill etc. before operating the equipment.
- Carry out no load run of motors etc.
- Check bearing temperatures, vibration, over speed trips function of different
- Safety device and other relevant tests. Carry out adjustments as required.
- Make hot alignments and any adjustments required after equipment has been put in operation.
- Arrange for manufacturer representative for equipment as required during installation and/or pre-commissioning and commissioning.
- Carry out all modifications as found necessary during system check / Inspection from view point of operability, maintenance and safety of the system

iv. Flushing & Blowing

- Flushing schemes for various systems / subsystems / equipment should be prepared well in advance and to be submitted to Purchaser for approval.

- Perform flushing using fresh treated water and blowing using air of all piping to remove dirt, welding slag, etc. after hydro testing (along with gasket / sheet blasting).

- Following rates of cleaning media to be maintained:
  Air -8-9 ft/sec.
  Water -3-4 ft/sec.

- System flushed with water shall be followed by blowing with air for removal of free water. System requires to be kept under inert pressure as recommended by bidder /bidders is to be kept under inert pressure.

v. Temporary Spools, Strainers, Screens and Blinds

- Provide and install all strainers, both temporary and permanent.
- Clean strainers as required during pre-commissioning and commissioning.
- Provide, install and remove all blinds required for flushing or operation. (Install and dismantle temporary pipe pools as and when required for pre-commissioning and commissioning).

vi. Leak, Vacuum and Pressure Tests

- Make non-operating leak tests and pressure tests on piping and all equipment, including field fabricated equipment.
- Conduct all tests in accordance with applicable statutory/safety/ other applicable design codes and specifications.
- Leak tests upto 5 kg/cm2(g) pressure to be carried out after purging /flushing. Further leak test at higher pressure shall be carried out in steps of 5/10 kg/cm²g of gas.
- Detailed procedure for leak and pressure tests on piping and field fabricated equipment shall be submitted by bidder to the Purchaser /PMC/ End Customer for approval.

vii. Safety Devices

- Provide a list of proper settings for safety devices to the Purchaser /PMC/ End Customer.
- Install all safety devices (including pressure relief valves) on the equipment after calibration test and adjust all safety device and seals wherever necessary or desirable.

viii. Purging

- Install necessary purge connections including installation of temporary purge piping or hoses to equipment connection and carry out system purging with inert gas.

ix. Drying Out (if applicable)

- Undertake system drying out operation as per approved operating procedure and guidelines for carrying out drying of heaters and major equipment, wherever dry out is necessary.

x. House Keeping

- Provide continuous clean-up of the construction and operational area.
- Remove excess materials, temporary facilities and scaffolding and pick-up trash.
- Perform washing for clean-up as required.

xi. Equipment Protection and Spare Parts

- Protect equipment from normal weather conditions, corrosion, or damage before commissioning.

xii. Chemical Cleaning/Pickling (if applicable).

- Perform special chemical cleaning or pickling of the piping as required by specification.

xiii. Miscellaneous

- To carry out any other check / test as required by Purchaser /PMC/ End Customer Representative and provide all test certificates as required by the Purchaser /PMC/ End Customer Representative.

xiv. Operability Test for a System / Equipment

- Each system / equipment shall be given operability test for sufficient duration (not less than 4 hours) to demonstrate worthiness of the system for normal operation.
- The bidder shall provide his proposal / procedures for carrying out the operability test of each equipment / system to prove that the equipment system installed meet the design specification.
- This shall also include the supply of log sheets wherein the operating parameters shall be recorded hourly.
- The operability test shall be carried out by the bidder in presence of Purchaser /PMC/ End Customer Representative and the bidder representative.
- The bidder shall make necessary checks, adjustments, repairs required for normal operation of the system / equipment.
- All the safety devices shall be tried for their proper operation.
- Upon completion of the operability test the log sheet with all observations shall be signed by the bidder, Purchaser /PMC/ End Customer Representative.
- The performance shall be evaluated based on the data and observations made during the operability test.

xv. SPECIFIC PROCEDURES

- In addition to the work to be performed in accordance with the above, the detailed procedures outlined below further define the work responsibilities of the bidder for specific systems and items of equipment:

12.7.0 READY FOR COMMISSIONING

12.7.1 The system/unit shall be considered `Ready for Commissioning' when all the facilities have completed along with their auxiliaries and support facilities in every respect including charging

of lubes, chemicals, preparation of solution, any last minute modifications, if any, as recommended by the purchaser/PMC/ End customer.

12.7.2 All temporary structures, scaffolding etc. used for carrying out the pre-commissioning works shall be removed, all the blinds shall be put into position as required by P&IDs

12.7.3 All systems as recommended shall be purged and pressurized.

12.7.4 All pre-commissioning and other documents shall be handed over to the Purchaser.

12.7.5 Bidder shall issue a certificate of ready for commissioning of system/unit for acceptance by the Purchaser /PMC / end customer in standard format with all exceptions resolved.

12.7.6 After the process unit has been declared as `Ready for Commissioning', bidder shall not carry out any hot work in the system/unit without prior written permission of the Purchaser.

12.8.0 COMMISSIONING

12.8.1 It shall be the responsibility of the bidder to commission the Air Conditioning System

12.8.2 Commissioning will be carried out under necessary guidance and overseeing of representatives of Purchaser /PMC/End Customer after mechanical completion is over successfully, all pre-commissioning activities are carried out and certificate of “Ready for commissioning” is accepted by Purchaser /PMC/End Customer.

12.8.3 Bidder shall provide necessary co-ordination during start up and technical clarification will be furnished by them.

12.8.4 The Air conditioning system shall be considered to be commissioned successfully when the system/unit, with instrumentation / control systems, process, utilities and support systems have been on uninterrupted stable operation for not less that 72 hours.

12.8.5 Whether the 72 hours operation has been successful or not, shall be decided by the Purchaser / PMC / End Customer based on observations recorded during 72 hours.

12.8.6 The countdown for 72 hours operation shall start only after unit has been on stable operation with all controls and safety system in normal operation for a period of not less than 48 hours.

12.8.7 Bidder is also required to provide on the job training to Purchaser /End Customer’s operation personnel by associating them in all the day to day pre-commissioning, commissioning and maintenance activities and process operations, however, responsibility for adequate manning the system shall be that of bidder.

12.8.8 After successful commissioning of the system/unit as above the same shall be handed over to the OWNER for operation.

12.8.9 In case of any constraint in achieving the above process parameters in the plant, the same shall be communicated by the bidder to the Purchaser in writing. This will be reviewed jointly by Purchaser /PMC/End Customer to arrive at a decision on whether the constraint is on account of reasons attribute to the bidder or not. In case the constraints are found due to reasons attributable to the bidder, bidder shall take all remedial actions as per the decision of the purchaser. Bidder, however, shall not be eligible for any commercial claim on account of this.

12.8.10 Bidder in some cases may be required to do part commissioning of the mechanically completed sections of the system/unit as per directives from the Purchaser /PMC/End Customer.

12.8.11 Upon successful commissioning of the units the same shall be taken over by the OWNER for day to day operation and maintenance only. Final takeover shall be subject to compliance to all the contractual obligations by the bidder.

12.9.0 PERFORMANCE TEST RUN

12.9.1 After the units have been completed, put into operation and steady state operation is established, performance test of units shall be conducted.

12.9.2 Before carrying out of the performance test of units, bidder shall develop a procedure/protocol and schedule in consultation with the OWNER / PMC/ VENDORS and submit to Purchaser /PMC/End Customer for their approval.

12.9.3 The performance test is to be carried out as soon as practicable after the commissioning.

12.9.4 Among the other things the procedure shall broadly include the following.

- Test conditions
- Log sheet for recording operating data
- Sampling methods
- Analytical methods
- Methods of calculations
- Pre-test run period, if any
- Methodology for interpretation and measurement of tests
- Methodology for taking operating data and its frequency
- Methodology for evaluating the performance of the unit, feed/utilities/energy consumption, yields etc

12.9.5 The bidder shall provide the services of his commissioning engineer who was associated with the commissioning of the process units at site during this performance test run period.

12.9.6 Bidder shall be held responsible for any defects noted during performance test run and attributable to him and shall be dealt as per the relevant provision of the contract.

12.9.7 The performance test shall be carried out by operating the units for a minimum period as specified for the unit continuously for guarantee test.

12.9.8 The results obtained during that period will form the basis of comparison between the actual performance and bidder’s process guarantees.

12.9.9 Measuring methods, tolerances, instructions for analysis and calculations shall be as per accepted practices and shall be mutually agreed upon before the start of performance test.

12.9.10 Interruption (Max. 3 Nos.) in the running of the units for less than five minutes during performance test shall be ignored.

12.9.11 If a performance test of units has been carried out successfully for a period as specified and bidders's guarantees are met, then the performance test shall be deemed to have been successfully completed.

12.9.12 Until bidders’ guarantees have been met additional performance tests shall be conducted, in the same manner as the first performance test.

12.9.13 After completion of a performance test, all relevant operating and production figures shall be recorded in a protocol to be signed by authorized representatives from bidder, Purchaser /PMC/End Customer

12.9.14 Bidder shall prepare test report and submit to OWNER/PMC within 15 (fifteen) days after the completion of each performance test.

12.9.15 In case the performance test fails to meet guarantees, the authorised representative of both bidder and OWNER/PM Purchaser /PMC/End Customer C shall mutually discuss and determine the causes of failure of the test. Necessary modifications required will be suggested by bidder in writing and if the cause of failure is attributable to bidder , cost of these modifications shall be borne by bidder.

12.10.0 MANUFACTURER'S REPRESENTATIVE

12.10.1 It shall be bidder's responsibility to arrange for services of manufacturer's installation / commissioning engineer at site during mechanical completion / pre-commissioning & commissioning of all the major equipment and systems listed as under:

- VAM , AHU , Cooling Towers
- All critical pumps and blowers.
- PLC.
- Any other critical/proprietary equipment, for which it is felt necessary to call Vendor's representative for proper commissioning

12.10.2 Bidder shall plan all such visits in advance, so that the there is no hold and subsequent delay at site.

12.10.3 In emergency circumstances, bidder shall immediately arrange for the visit of manufacturer's expert.

12.10.4 All the cost including that towards boarding, lodging, servicing, Insurance, Local Travel, Service charges etc for arranging all the above visits shall be deemed to be included in the bidder's quoted price. Bidder shall not be eligible to raise any extra claim in this regard.

13.0.0 INSPECTION AND TESTING

Bidder shall maintain an effective Quality Assurance System, to ensure that all equipment and material supplied as a part of the Air Conditioning System package meet required Quality standards and specifications.

13.1.0 INSPECTION (Please refer Annexure-19)

13.1.1 Bidder, to ensure that the equipment and material supplied, meet all the specifications laid down in the contract

13.1.2 In case bidder find any deviation or non-conformity with respect to the agreed specifications, during manufacturing of the item and where corrective action is not feasible, the bidder shall report the same to Purchaser and / or PMC in the designated "Waiver / Deviation Request" format and seek prior approval from Purchaser /PMC before proceeding with the job.

13.1.3 Bidder shall notify in writing to the Purchase, at least two weeks (Ten working days) in advance of the date and the place at which the items will be ready for witnessing of inspection / testing by Purchaser and / or PMC In case any postponement becomes necessary, the CONTRACTOR shall provide written notification at least 48 hours prior to the original scheduled date.

13.1.4 Bidder after satisfying that all inspection requirements as per approved ITP and applicable specifications / documents have been taken care by TPIA, shall submit copy of the Inspection

Certificate and all Quality control records to Purchaser in requisite copies along with Statutory Certificates if any, such as IBR, CCE etc. duly endorsed by their Quality Control Manager.

13.1.5 The bidder shall ensure that all items covered by IBR/CCE regulations are inspected at the manufacturer's works and duly certified by competent authority.

13.1.6 Purchaser and / or PMC – End customer reserve the right to carry out surprise checks on all material either at manufacturer's works or at site. In case of any rejection at site, the whole lot will be rejected and bidder shall get the entire lot replaced without any time or delivery implication to the purchaser.

13.1.7 TPIA shall check the calibration status and traceability of all instruments used by the supplier, for testing. In case, TPIA uses their own instruments for testing purposes, similar certification shall be ensured.

13.1.8 Dimensional check up to a minimum of 10% should be done for all pipes and fittings at supplier's shop and witnessed by TPIA. Additionally 1% dimensional check will be carried out at site by the bidder and witnessed by Purchaser /PMC.

13.1.9 In case any non-conformity is noticed, 100% of the lot shall be checked by TPIA and all non-conforming material shall be replaced by the bidder.

13.2.0 Inspection Agency:

BHEL / Third Party appointed by BHEL / Customer / Customer appointed third party.

The inspection agency shall be indicated in the quality plan and shall be as per the approved quality plan.

13.3.0 GUARANTEE (Please refer Annexure-19)

The Bidder shall guarantee the specified inside design conditions for one year for air-conditioning system after successful handover of the system to Purchaser/ End customer.

After completion of the installation, the system shall be balanced and necessary adjustments shall be carried out for all equipment until all guaranteed performance requirements are satisfied.

All instruments and services required for the above tests shall be provided by the bidder.
All the instruments installed and required for conducting acceptance test shall be only calibrated instruments

14.0.0. MARKING , PACKING AND DESPATCH

14.1.0. MARKING

14.1.1. All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.

14.1.2. For ease of identification, the color of painted strip (wherever required) shall be as per the applicable standard.

14.1.3. Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

14.2.0. DISPATCH

14.2.1. All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling.

14.2.2. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.

14.2.3. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

14.3.0. The following minimum packing procedures shall be followed :

14.3.1. All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.

14.3.2. Open space will be allocated to vendor for storage at about three km from site of erection. Vendor to make adequate/proper packing of the material at the time of dispatch to avoid cases of theft/misplacement of material at site.

14.3.3. **Item dispatch in sacks or loose items etc. to be avoided. No dispatches shall be made in LOT/SET.** Loose items sent by bidder to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.

14.3.4. A packing list covering items having shelf life are to be intimated to site. Also, shelf life items shall be packed separately in black color painted box for easy identification at site.

14.3.5. Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.

14.3.6. Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.

14.3.7. All instrumentation items shall be properly packed to prevent damage during transit due to vibration, physical contact, moisture ingress, rainwater and pilferage.

14.3.8. All the items which the Bidders considered liable to be damaged during shipment or storage, shall be packaged for separate shipment. If instruments are removed from the panel, they and their connection shall be suitably tagged to ensure simple re installation at the job site. Each instrument shall be sealed in plastic bags containing moisture absorbing desiccants.

14.3.9. It shall be bidder's sole responsibility to protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and including delays in transit. Bidder shall be responsible for any damage to equipment/material due to above reasons.

14.3.10. Spare parts shall be packaged separately in a green color painted box and clearly marked as 'Spare Parts'

15.0.0. SITE FACILITIES:

15.1.0. The material shifting from BHEL storage yard to place of erection (inside NALCO site) shall be in the scope of vendor only. As erection is in vendor's scope, material handling during erection shall also be in Vendor scope. Storage Yard is outside of NALCO campus and is approx. 3 km from site.

15.1.1. Vendor to make adequate/proper packing of the material at the time of dispatch to avoid cases of theft/misplacement of material at site. **Item dispatch in sacks or loose items etc. to be avoided.**

15.2.0. Bidder to make own arrangement for material handling like hydra type mounted crane for carrying out material loading & unloading and erection activities. Crawl cranes are not allowed; only tyre mounted cranes are allowed. Proper load testing of all jacks, lifting equipment shall be carried out by bidder.

15.3.0. It is advised to Bidders to visit the site and ascertain all site intensive requirements such as Health, Safety and Environment (HSE) requirement, work permits and other special requirements of site etc. All personnel protection equipment shall be provided and all other prevailing safety rules and regulations shall be followed. All contract workmen shall be covered under ESI & PF. They shall enter the refinery with valid photo entry passes. Please refer annexure-20 for compliance.

15.4.0. BHEL/ NALCO shall be exempted from all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Bidder, his agents, his employees, his representative and sub-contractors or from riots, strikes and civil commotion. Please refer Annexure-21 for compliance.

15.5.0. The bidder shall arrange all instruments and services required for the performance testing at site and works.

15.6.0. Surplus / excess material, scrap, is the property of the purchaser.

15.7.0. It is considered that enough clarity is brought by BHEL regarding the site front facilities. Further, bidder is informed to visit site and ascertain all site intensive requirements, such as facilities indicated above, work permits, safety, security, special requirement etc.

15.8.0. Scope Demarcation for Site Facilities:

S.No.	Description	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
1.0	**ESTABLISHMENT**		**YES**	
2.0	**FOR CONSTRUCTION PURPOSE**:			
a	OFFICE SPACE	YES		
b	Open space for storage (as per availability)	YES		Open space will be allocated for storage at about three km from site of erection.
c	Construction of bidder's office/ canteen and storage building including supply of materials and other services		Yes	
d	Bidder's all office equipments, office / store / canteen consumables		Yes	
e	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
f	Firefighting equipment like buckets, extinguishers etc		Yes	
g	Fencing of storage area, office, canteen etc of the bidder		Yes	
3.0	**FOR LIVING PURPOSES OF THE BIDDER**			
a	Open space for labor colony (as per availability)		Yes	
b	Labor Colony with internal roads, sanitation, complying with statutory requirements		Yes	
4.0	**ELECTRICITY**			
4.1	**Electricity for construction purposes 3 Phase 415/440 V**			**On Chargeable Basis.**
a	Single point source	**YES**		
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
4.2	**Electricity for the office, stores, canteen etc of the bidder**			**On Chargeable Basis.**
a	Single point source	**YES**		
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	

S.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
4.3	**Electricity for living accommodation of the bidder's staff, engineers, supervisors etc.**		Yes	
a	Single point source		Yes	
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
5.0	**WATER SUPPLY**			
5.1	**For construction purposes:(to be specified whether chargeable or free)**			
a	Making the water available at single point	**YES**		
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
5.2	**Water supply for bidder's office, stores, canteen etc**			
a	Making the water available at single point	**YES**		
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
5.3	**Water supply for Living Purpose**			
a	Making the water available at single point		Yes	
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
6.0	**LIGHTING**			
a	For construction work (supply of all the necessary materials) 1. At office/storage area 2. At the preassembly area 3. At the construction site /area		Yes	
b	For construction work (execution of the lighting work/ arrangements) 1. At office/storage area 2. At the preassembly area 3 At the construction site /area		Yes	
c	Providing the necessary consumables like bulbs, switches, etc during the course of project work		Yes	

S.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
d	Lighting for the living purposes of the bidder at the colony / quarters		Yes	
7.0	**COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER**			
a	Téléphone, fax, internet, intranet, e-mail etc.		Yes	
8.0	**COMPRESSED AIR WHEREVER REQUIRED FOR THE WORK**		Yes	
9.0	**DEMOBILIZATION OF ALL THE ABOVE FACILITIES**		**YES**	
10.0	**TRANSPORTATION**			
a	For site personnel of the bidder		Yes	
b	For bidder's equipment and consumables (T&P, Consumables etc)		Yes	
11	Material Handling Arrangement (Hydra/Crane etc.)		Yes	

Notes:

1. *Bidder to note that they have to comply with the special requirements of project site, if any, during order execution stage without any price implication to the Purchaser.*

16.0.0. DOCUMENTATION:

16.1.0. MASTER DOCUMENT LIST

a) Bidder shall ensure submission of all documentation as per Master Document List as attached in the purchase specification. Bidder to note that the list as indicated in MDL are minimum documents, however additional documents required to complete the Spray package shall be included in MDL in contract execution stage.

b) Bidder shall ensure that all drawings and documents shall be PDF for official submission. However AutoCAD verison of drawings shall be submitted alongwith official submission for our records.

c) BHEL shall consider the submission of soft copy as the submission date for the drawing. Submission of soft copy shall be followed by submission of two sets of Hard copies for review and return.

d) Approved documentation/ As built documentation shall be submitted in 10 sets of hard copies and three compact Discs/ DVDs.

e) Bidder shall ensure submission of all documentation as per approved Master Document List.

16.2.0. DRAWING APPROVAL / REVIEW CATEGORY:

a) Following classes of review shall be followed for all the documents engineered by the bidder

- APPROVAL (A)
  Approval is mandatory and bidder cannot proceed without obtaining Purchaser's approval (eg. Layouts, schemes etc.)

- INFORMATION / RECORDS (I)
  This type of documents shall be submitted to Purchaser for his information (eg. data sheets, GA drawings etc.)

  Type of Code used as per BHEL for approval/commnets of Documents:
  Code-1 : No comments
  Code-2 : Comments as marked cleared for manufacturing
  Code-3 : Comments as marked but not cleared for manufacturing
  Code-4 : Reatnied for information

16.3.0. DRAWINGS REVIEW AND APPROVALS PROCEDURE

a) Bidder to understand that efficient handling of drawings and documents to be prepared by him under the contract is the key to the timely completion of the system. By accepting the contract the bidder undertakes to ensure that all drawings and documents to be submitted by him to the Purchaser/ End Customer shall be of professional quality and conforming to the contractual requirements.

b) Each drawing submitted by the bidder shall be clearly marked with the name of the Owner, the unit designation, the specifications, title, the specification number and the name of the Project with revision No. and date. If standards, catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English.

c) Approval/review of drawings do not absolve the bidder from in-correct/faulty design or manufacturing of equipments/materials. It is the sole responsibility of bidder to rectify the faulty or incorrect designs at any stage of contract.

d) Review of drawings and documents issued by bidder shall be carried out by Purchaser /End customer.

f) The first submission of drawings shall start within 15 days from the date of Purchase order. All the first submission shall be completed within 45 days from the date of Purchase order.

g) All the engineering documentation including revised submission shall be completed within 90 days from the date of purchase order. In other words, the system engineering shall be completed within 3 months from the date of purchase order.

h) All revised drawings after incorporating the comments shall be furnished within 15 days. BHEL shall furnish comments (if any)/approval on the documents within 15 days after the receipt of same.

16.4.0. FOLLOWING MAY BE NOTED WRT THE DRAWING SUBMISSION SCHEDULE:

SL NO.	DESCRIPTION	NUMBER OF COPIES TO BE SUBMITTED	WHEN TO SUBMIT
1	Initial drawings/documents under approval and information category.	1	As per approved Master document list
2	Revised drawings/documents incorporating BHEL's comments.	1	Within 1 week of receipt of commented Drawings from BHEL
3	Final Drawings/documents	16	Within 2 months of placement of order.
4	Erection Documentation	16	1 Month before dispatch of equipment, The list of documents identified under master document list for erection to be furnished in 5 nos. of folders.
5	Draft O & M Manuals with out test certificates	2	2 months before the delivery date of equipment
6	Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)	18	Within one month after dispatch of equipment
7	Final O&M Manuals in a CD	3	Within one month after dispatch of equipment

16.5.0. IBR DOCUMENTATION:

16.5.1. Bidder to furnish 8 sets of following IBR documentation folders for taking necessary approvals by BHEL / IBR INSPECTOR /CIB.

1) IBR isometric drawing indicating support locations, maximum stress point, Bill of material, support sketches.
2) Pipe thickness calculations
3) Piping stress analysis calculations.

16.6.0. DOCUMENT SUBMISSION PROCEDURE

16.6.1. All Drawings/Datasheet/Design calculation etc. shall be submitted in soft as well as hard copy.

16.6.2. Soft submission of all drawings/documents is mandatory.

16.6.3. All drawings/ shall be submitted in auto cad format & all documents in MS office/PDF.

16.6.4. It has been observed that at times mails fail to deliver because of problem in sender's /receiver's server.
Hence it will be mandatory on the part of bidder to intimate concerned BHEL personal about any soft copy submission over phone immediately after any drawing /document is submitted for BHEL's review / approval.

16.6.5. Hard copies of all the documents shall be forwarded to the following address:
Name: (Name will be intimated during detail engineering)
Address: Bharat Heavy Electrical Limited
New PESD Building
RC Puram, Hyderabad- 32

16.6.6. Date of receipt of hard copies shall be considered as date of submission of any document. Soft copy submission shall be considered as advance submission of drawing/document

16.6.7. BHEL's normal working hour is 8.00 AM to 4.30 PM from Monday to Saturday.
Bidder to ensure that all documents are received with in BHEL working hours. Any submission done after normal office hour/ weekly Off/Public Holidays shall be deemed as submitted on next working day.

16.6.8. BHEL shall furnish Approval/Observation of Drawings/Datasheet/Design calculation etc. on Soft Copy only.

16.7.0. INPUT DRAWINGS

16.7.1. On receipt of order, it shall be solely the bidder's responsibility to spell out the requirement of the base engineering drawings/documents required by him to go ahead with the engineering of the package, and shall not expect the Purchaser to automatically supply the same after order placement – the required base drawings/documents shall be furnished to the Bidder within reasonable period of receipt of such requisition from Bidder. Any ultimate delay arising out of the delay by the successful bidder in putting up such a requisition shall solely be to the bidder's account. The issues related to engineering input data shall be settled within 30 days from the date of purchase order.

16.7.2. **A kick of meeting shall be organized at BHEL within 15 days after the award of contract to bidder. All the issues related to project like, engineering input exchange, communication procedure etc, shall be discussed and mutually agreed upon.**

16.7.3. Drawings attached with this specification are preliminary in nature & are not exhaustive. These drawings may get revised and /or new drawings will be furnished to bidder during detail engineering .Bidder to however note that they will not be eligible to raise any extra charges on account of this

16.7.4. All relevant input drawings will be made available to the bidder during detail engineering stage as when they are revised or prepared.

16.7.5. Bidder to note that they won't be eligible to raise any extra claim on account of furnishing of new drawings or revised drawings by BHEL during offer execution stage.

16.8.0. REVIEW MEETINGS & KICK OFF MEETING:

16.8.1. A kick off meeting shall be held at Purchaser's office, preferably within 15 days of receipt of order

16.8.2. An agenda shall be prepared for this meeting and would include the following points related to technical aspects.

a. Any clarifications required by the Bidder on purchaser's order.
b. Bidder Data Index & Schedule.
c. Bidder Data Review/approval modalities.
d. Sub-Bidder lists proposed by Bidder.
e. Utility requirements.
f. List of input drawings required from BHEL
g. Preliminary General Arrangement & layout drawings

16.8.3. As and when required, the bidder will be called upon to attend design co-ordination meeting / review meeting with the end customer/PMC /BHEL during the period of the Contract. The Contractor shall attend such meetings at his own cost at venues decided by BHEL.

16.9.0. AS BUILT DRAWINGS

16.9.1. As built drawings and documents will be generated within one month of completion of activities on respective items of work.

16.9.2. Bidder shall furnish reproducible and electronic files of all the drawings under their scope to Owner/ certified as "As Built Issue."

16.10.0. OPERATION AND MAINTENANCE MANUAL

16.10.1. Bidder shall prepare and submit draft maintenance manual to Purchaser for review at least three months prior to the mechanical completion.

16.10.2. Final maintenance manual incorporating all comments shall be submitted by bidder within one month after issue of comments.

16.10.3. O&M shall consist of the following as minimum:

i. Operation and maintenance procedures of all equipments
ii. Approved drawings/Datasheets
iii. GA drawing and catalogue of all equipments
iv. Quality plan
v. Test certificates
vi. Installation procedure.

17.0.0. SUB VENDOR LIST

17.1.0. All the equipment shall be sourced from recommended Bidders only as specified in this specification (Refer Annexure-7).

17.2.0. Sub vendor shall be ISO certified company.

17.3.0. Supply items for which no definite "make/brand" is indicated, shall be procured only from makes & models having proven track records and requires purchaser approval.

17.4.0. Bidder may propose additional sub vendors for items that have three vendors or less in the vendor list given in annexure-7. These proposed vendors shall have proven track record (validated with credentials) for the above items and subjected to BHEL / customer approval during post ordering of the package.

17.5.0. Bidder to comply with sub-vendor list enclosed with the specification. If any item is left over other than indicated in the sub-vendor list, sub-vendor name shall be furnished to BHEL/ customer approval. Non-acceptance of any sub-vendor by BHEL / customer shall not have any commercial & delivery implication. While submitting sub-vendors for approval of BHEL, bidder shall furnish following documents :

i. ISO certificate of Sub-vendors
ii. Proven track record for makes and models supplied earlier.

18.0.0. PRICE BID FORMAT (Annexure-1)

18.1.0. Air conditioning system as envisaged in this bid document shall be executed by the bidder on Lump Sum Turnkey (LSTK) basis.

18.2.0. All the items included in the price bid format shall be quoted as per tender specification and subsequent tender stage correspondences, if any. Responsibility of ensuring correctness & completeness of scope of supply as per spec. requirement solely lies with bidder.

18.3.0. Prices quoted by the bidder shall remain firm till the successful handing over of the Air conditioning plant to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

18.4.0. Bidder to refer to GCC & SCC for the applicable taxes and duties. Bidder to quote only base rates for all the items. Applicable taxes and duties shall be indicated separately.

18.5.0. The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment. Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be in bidder scope only. It will be the bidders sole responsibility to specifically highlight any of the missing equipments / items required for the proper & intended use of the Air Conditioning System as a part of their offer. In case nothing is highlighted by the bidder, it will be assumed that all the

major items are included in the bidder's scope of supply for the desired operation of the AC system.

18.6.0. All hardware/software/item/ etc. required as per tender specification or subsequent tender correspondences or for desired satisfactory operation of package or due to good-engineering practice or as prescribed by relevant/applicable code/standard, but not listed exclusively in this specification, shall be deemed to be included in the basic price quoted by the bidder. Also, all mounting hardware / accessories /fittings/conduits/etc. required for above the package shall be included in the basic price of respective item. Bidder, at no point of time, shall be eligible to raise any extra claim in this regard.

18.7.0. Drawings attached with this specification are preliminary & are not exhaustive in nature. These drawings may get revised during detail engineering. All other inputs required for engineering of the Air conditioning system will be furnished to the bidder during detail engineering stage, as and when the same is available with BHEL. Bidder to note that they shall not be eligible to raise any extra claim on account of revision of input drawings or any other input drawings during detail engineering stage.

18.8.0. Bidder shall confirm that he has quoted all items by marking "Quoted" in the price bid and enclose the same in their technical offer. Price shall not be specified in the technical offer.

19.0.0. BILLING BREAKUP METHODOLOGY

19.1.0. Billing break-up (BBU) shall be submitted to BHEL in following methodology

19.2.0. The BBU shall be prepared only for the pro-rata billing purpose.

19.3.0. BBU will contain complete list of items required for the completion of the project as per specification and shall be dispatched by bidder irrespective of the items/quantities are indicated in the document or not.

19.4.0. Any additional requirement of the item already indicated in the document will be updated in the subsequent revision of this document. All such item will be dispatched as "free item" term to BHEL.

19.5.0. Inspection & Testing of all items shall be as per approved quality plan. The entire item shall be dispatched to site only after the completion of Inspection and testing requirement as per approved quality plan. Non-inclusion of any item does not absolve the vendor from meeting the requirement.

19.6.0. Vendor shall obtain prior permission from BHEL after submitting all the documents before ensuring dispatch of all main items applicable for project.

19.7.0. Inspection & quality: All the items applicable for this project shall be inspected as per approved quality plan. It may be noted that any item shall be dispatched to site only after complying with the Inspection requirements as per approved quality plan.

19.8.0. As separate document indicating the details of all the items having SHELF LIFE shall be furnished. Prior permission from BHEL shall be taken before dispatch of any of the item having shelf life.

19.9.0. Applicable taxes & duties shall be extra.

19.10.0. BBU shall be a comprehensive document having details of all the items applicable for this project. There should not be any Non-Billable item to be supplied at site.

19.11.0. Wherever Lot items are indicated, same shall be quantified in details in a separate annexure. Similarly all Accessories/ Instruments/ items are to be defined with comprehensive details.

19.12.0. In case requirement of any such item / additional item is detected at any stage of the contract execution, BBU will be revised to reflect the same. However all the additional items will be supplied as a 'Zero Value Item', without any commercial implication to BHEL. All the contractual requirements shall be valid for these additional items also.

20.0.0. DEVIATIONS TO SPECIFICATIONS:

20.1.0. Bidders are advised to quote strictly as per BHEL's specification requirements. In case bidder excludes some components of scope of supply or some features of specification requirements, the bidder will be required to include the same in the scope during offer evaluation stage /contract execution stage without any additional commercial and price implications on account of the same. Bidder to note that they won't be entitled for any price impact on account of withdrawal of deviation taken from BHEL spec at any stage. Price impact will be allowed by BHEL only to the extent of change of specification during tender evaluation stage, if any, from BHEL end.

20.2.0. In case bidder feels that it is necessary to exclude some components of scope of supply & some features of specification requirements, due to genuine constraints if any, bidder has to clearly bring out the same to the notice of BHEL and take their prior approval before submission of bid. Bidders are requested to bring out only those deviations which are impractical to meet (or) not technically advisable as per the experience of bidder, for BHEL's review before the submission of bid. All such clarifications required by the bidder shall be intimated to BHEL together as a single notice within a week of receipt of enquiry by bidder.

20.3.0. All such deviation or variation from the scope, requirement and/or intent of this specification shall be clearly defined under relevant attachment of the Bid forms irrespective of the fact that such deviations/ variations may be standard practice or a possible interpretation of the specification by the Bidder. Except for those deviations/ variations covered as a part of pre bid clarification, it will be the responsibility of the bidder to fully meet the intent and the requirements of the specification within the quoted price. No other deviation whatsoever from this specification, except for the those that have been specifically agreed by purchaser as a part of pre-bid clarification shall be considered.

20.4.0. Bidder to note that all such applicable deviations /clarification shall be listed separately in the format attached with this specification (Annexure -2) and submitted to BHEL as a part of pre-

bid querry. All such applicable deviations /clarification shall have cross reference to page number /section / clause /para etc. of this specification or its annexure with proper reasons for the deviations for purchaser's consideration. Any such applicable deviations /clarification not listed under the above section, even if reflected in any other portion of the bidder's proposal shall not be considered applicable.

20.5.0. In case the vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.

21.0.0. DEFINITIONS

21.1.0. BIDDER/VENDOR: Bidder means the party supplying Air Conditioning system for this project.

21.2.0. SUB VENDOR : Sub vendor means any party on whom bidder suborders materials and items (like tubes, forgings etc)

21.3.0. QUALITY ASSURANCE PLAN (QAP) / INSPECTION AND TEST PLAN (ITP) :
It is a document generated by the supplier with complete listing of various inspection stages, tests, material certification requirements and parties involved with their respective roles in inspection; indicating the requirements of Hold (H), Witness (W) Inspection, and Review (R) of Quality control documents / records for an item. QAP and ITP are considered synonymous.

21.4.0. HOLD POINT: A Hold Point is a stage designated in the ITP/QAP, which requires Witness Inspection by TPIA and / or PMC/OWNER before supplier can proceed with further processing, except where prior written permission for further processing or waiver of Witness Inspection by PMC / OWNER is obtained.

21.5.0. WITNESS POINT A Witness point is a stage designated in the ITP/QAP, which requires witness inspection by TPIA, PMC and / or Owner. EPCC/LSTK CONTRACTOR / Supplier shall perform the activity after proper notification has been given to TPIA / PMC and OWNER for witnessing the activity. The CONTRACTOR/ Supplier is not obliged to hold further processing, if TPIA / PMC and / or OWNER are not available to witness the activity or does not provide the comments before the date notified with proper notification period.

21.6.0. REVIEW POINT A review point is a stage designated in the ITP/QAP which requires the concerned agencies i.e. CONTRACTOR / TPIA / PMC/OWNER, to verify the documents for their correctness and to confirm that the said documents meet the requirements laid down.

21.7.0. THIRD PARTY INSPECTION AGENCY (TPIA) Third Party Inspection Agency means an inspection agency appointed by the EPCC/LSTK CONTRACTOR for carrying out Inspection and witness of tests of equipment and material being procured by the CONTRACTOR for the Project.

21.8.0. INSPECTION CATEGORY Inspection category determines the scope of Inspection for the Supplier, TPIA, PMC / OWNER for various equipment and material depending upon their use, serviceability, safety criteria and complexity.

21.9.0. MECHANICAL COMPLETION :Mechanical Completion of systems shall mean that all installation works of the system have been completed and hydro tested in accordance with approved construction drawings, approved specification, applicable code as defined in the document, accepted international good engineering practices and all the activities have been completed in a comprehensive manner by the bidder.

22 LIST OF ANNEXURES:

Following input documents and specifications are enclosed to facilitate the bidder to furnish the offer:

Sl. No.	Document/ Drawing Title	Doc. no.
1.	Price Bid Format	Annexure-1
	Format for Recommended Spare List	Annexure-1A
2.	Pre-Bid Query Format	Annexure-2
3.	Master Document List	Annexure-3
4.	Guidelines for preparation of Quality Assurance Plan	Annexure-4
5.	Manufacturing Quality Plan	Annexure-5
6.	Project Description	Annexure-6
7.	Sub-Vendor List	Annexure-7
8.	Domestic Packing Procedure	Annexure-8
9.	NO Deviation Format	Annexure-9
10.	P&ID for VAM based AC	Annexure-10
11.	P&ID for MP Steam	Annexure-11
12.	Technical Specification for AC System	Annexure-12
13.	Technical Specification for Package AC	Annexure-13
14.	Technical Specification – C&I	Annexure-14
15.	Technical Specification for Electrical Items	Annexure-15
16.	Technical Specification – Piping	Annexure-16
17.	Piping Material Specification (PMS)	Annexure-17
18.	Technical Specification – Painting	Annexure-18
19.	Inspection & Testing	Annexure-19
20.	HSE Plan for Bidders	Annexure-20
21.	SCC regarding Insurance	Annexure-21
22.	List of Standards & Codes applicable	Annexure-22
23.	Plot Plan	Annexure-23
24.	TG Hall Equipment Layout	Annexure-24
25.	TG Area Switchgear Eqpt Layout	Annexure-25
26.	Drive Control Philosophy	Annexure-26
27.	Layout of ESP cum Chiller Bldg.	Annexure-27
28.	Layout of Ammonia Storage Bldg.	Annexure-28

29.	Pipe Rack Layout	Annexure-29
30.	Available Power supply	Annexure-30
31.	P&ID FOR CONDENSATE & MAKE UP WATER SYSTEM	Annexure-31
32.	Panel Heat Dissipation Rate	Annexure-32
33.	Instrument Datasheet	Annexure-33
34.	Technical Specification of PLC for VAM BOM for VAM PLC PLC Configuration Diagram	Annexure-34 Annexure-34A Annexure-34B
35.	Quality of Filtered Water	Annexure-35

Notes:

Incase if bidder found any document/annexure no. listed in the technical specification and is missing from the attachment, it is bidder's responsibility to highlight the missing attachment.

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Prepared by	Approved By
00	25.05.21	ORIGINAL ISSUE	-sd-	-sd-

Ref. Doc.