

**INQUIRY FOR DESIGN, SUPPLY, INSTALLATION AND
COMMISSIONING OF REFRIGERATION SYSTEM**

FOR

**CORE PROCESSING FACILITIES
AT MUDARDA VILLAGE,
MEHSANA,
GUJARAT.**

JANUARY, 2018

**OWNER
FANIDHAR MEGA FOOD PARK PVT LTD.
10/11, SECOND FLOOR,
ORCHID THE SHOPPING MALL,
THALTEJ SHILAJ ROAD,
THALTEJ, AHMEDABAD
GUJARAT-380059**

**PROJECT MANAGEMENT CONSULTANT
TECHNOPAK ADVISERS PVT. LTD.
GURGAON**

INDEX

SECTION - A: INVITATION TO TENDER DESIGN, SUPPLY, INSTALLATION, AND COMMISSIONING WORKS OF REFRIGERATION SYSTEM	3
SECTION – B: TECHNICAL SPECIFICATION FOR REFRIGERATION SYSTEM.....	8
SECTION- 1: BASIS OF DESIGN.....	8
TABLE 1	8
TABLE 2	8
SECTION- 2: REFRIGERATION SYSTEM.....	9
1. REFRIGERATION COMPRESSORS:	9
2. ELECTRICAL MOTORS:.....	9
3. EVAPORATIVE CONDENSERS:.....	9
4. H.P.RECEIVERS	10
5. INTERCOOLERS:	10
6. HORIZONTAL L.P ACCUMULATOR SETUP:	10
7. REFRIGERANT PUMPS:	11
8. AIR COOLING UNITS (AMMONIA):.....	11
9. AMMONIA PIPING, FITTINGS & VALVES:.....	12
10. WATER PIPING, FITTINGS AND VALVES:	13
11. THERMAL INSULATION FOR PIPING, VESSELS ETC:	13
12. ELECTRICAL WORK FOR REFRIGERATION SYSTEM:.....	14
13. PLC PANEL:	15
14. SAMPLE INDEX FOR OPERATION & MAINTENANCE MANUAL:.....	17
15. GENERAL CONSIDERATIONS ABOUT REFRIGERATION	17
SECTION – C: TECHNICAL SEPCIFICATION FOR INSTALLATION & COMMISSIONING18	
1.0 MECHANICAL INSTALLATION.....	18
2.0 GENERAL INSTALLATION	18
2.1 POSITIONING OF EQUIPMENT	18
3.0 SERVICE PIPING INSTALLATION.....	19
3.1 GENERAL GUIDELINES	19
3.2 SCOPE OF SUPPLY	19
3.3 SCOPE OF PIPING ERECTION.....	19
3.4 OTHER GUIDELINES	19
4.0 CODES & STANDARDS:.....	21
5.0 INSULATION OF PIPING AND EQUIPMENT	21
6.0 INTERCONNECTIONS OF SERVICE AND ELECTRICALS WITH EQUIPMENT	21
8.0 GUIDELINES FOR EXPANSION WORK	22
9.0 CLEAN-UP OF WORKS SITE.....	22
10.0 TESTING, COMMISSIONING AND START-UP:	22
ACCEPTED MAKES OF MAJOR ITEMS	27

SECTION - A: INVITATION TO TENDER DESIGN, SUPPLY, INSTALLATION, AND COMMISSIONING WORKS OF REFRIGERATION SYSTEM

- 1.0 Tenders are invited for Design, Supply, Installation, and Commissioning of Refrigeration System for various CPC components in MFP at Mudarda Village, Mehsana, Gujarat, as mentioned in "Scope of Works" for Fanidhar Mega Food Park Pvt. Ltd. ("Owner").
- 2.0 Tender Documents shall be download from the website www.fmfp.co.in. A Tender processing fee (non-refundable) of Rs 10,000 to be submitted in form of cash or DD at the time of submission of tender.
- 3.0 Tender Documents will be submitted to

(A) Mr. Ajit Dhranga
+91-9586432323
E-Mail: info@fmfp.co.in

**FANIDHAR MEGA FOOD PARK PVT LTD.
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All inquiries and correspondence shall be directed in writing to the above **address**.

- 4.0 The tenderers should return their completed Tender in two parts – separately and distinctly marked (i) Volume – 1 of 2 (ii) Volume – 2 of 2 ("Tender"). The Tender will be received at the address given above by 3.00 p.m. local time on **05.02.2018**.

Submission of tender:	<p>1. The tenderer shall submit the documents in two separate envelopes marked as</p> <p>ENVELOPE 'A' –EMD and other all documents except price bid</p> <p>AND</p> <p>ENVELOPE 'B' – Technical Specification and Price Bid</p> <p>2. These two envelopes shall be packed in one cover envelope addressed as under – ADDRESS AS PER ABOVE</p> <p>3. Only the "ENVELOPE A" shall be opened first and eligibility of the tenderer shall be evaluated as per criteria defined above. "ENVELOPE B" shall be opened only for those tenderers who qualify as per the eligibility criteria.</p>
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5.0 Documents To Be Submitted –

- 5.01 Envelope A –
- 5.01.1 CA Certificate of last three years Turn Over
- 5.01.2 CA Certificate of company net worth

- 5.01.3 List of successfully completed projects of last three years with client name and contract value.
- 5.01.4 EMD of Rs 1 Lakh in the form of DD or BG in favor of Fanidhar Mega Food Park Pvt Ltd ; payable at Ahmedabad.
- 5.01.5 ITR last three years
- 5.01.6 Verifiable Client References
- 5.01.7 List of technical manpower
- 5.01.8 List of machines in manufacturing facility
- 5.01.9 Proof of technology association if any
- 5.01.10 Proof of international exposure

- 5.02 Envelope B
 - 5.02.1 Design Details
 - 5.02.2 PI Diagram
 - 5.02.3 Specifications
 - 5.02.4 Itemized Quotation

6.0 Eligibility Criteria

- 6.01 At least three completed projects of similar nature
- 6.02 At least two projects of 50 % of quoted price.
- 6.03 Average three years turnover should be more than or equal to the quoted price.
- 6.04 Organization should be profitable.
- 6.05 At least two projects of similar nature should be successfully running for last two years. Supporting proof to be attached.

7.0 Components from reputed OEM are accepted.

8.0 Typical Payment Terms

- 8.01 Mobilization advance to a max of 50 % against submission of equivalent amount of BG or a corporate guarantee
- 8.02 Max 40 % Payment against dispatch of plant and machinery
- 8.03 Max 5 % against installation and commissioning

9.0 Max 5 % against submission of BG valid for 12 months after acceptance of installation and commissioning report. The BG shall be released after completion of this defect liability period.

10.0 The Owner reserves the right to accept or reject any or all Tenders without giving any reasons thereof, in their sole discretion and without any liability or costs to the tenderer. The Owner clearly states that this is merely an invitation to an offer and is not an offer, and therefore makes no obligation in any way to pay any tenderer for any response or to award the tender or make any commitment to any tenderer whatsoever. The Owner may further waive any deviations which do not constitute a material modification in the Tenders received. In the event that there are any other material deviations in the Tender, the Owner may in its sole discretion reject and remove such deviations from the Tender and accept the same. The decision whether the deviation constitutes a material modification shall solely be that of the Owner and such decision shall be binding on the tenderer(s).

11.0 One Bid per Bidder

- a. Each bidder shall submit only one bid for one contract. A bidder who submits or participates in more than one Bid (other than as a Sub-contractor or in cases of

alternatives that have been permitted or requested) shall cause all the proposals with the Bidder's participation to be disqualified.

- b. Tender documents are not transferable.

12.0 Cost of bidding

The bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer shall in no case be responsible and liable for those costs.

13.0 Site visit

The Bidder may visit the site and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

14.0 Clarification of Bidding Document

- a. A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing by mail at the PMC's and Employer's mail address & indicated in the invitation to bid. The Employer shall respond to any request for clarification which he received earlier than 7 days prior to the deadline for submission of bids. Copies of the Employer's response shall be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its source.

15.0 Amendment of Bidding Documents

- a. Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing tender addends.
- b. Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing through email or by fax to all the purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum by fax to the Employer. Addenda shall be incorporated in the bids submitted by the Bidder

General Conditions

1. Co-ordination between different Agencies

The Contractor shall submit the details of Erection works programme to the engineer who will co-ordinate with the programme of the Civil / Mechanical / Electrical contractor separately submitted to him. Such co-ordination of Civil / Mechanical / Electrical and Erection works programme shall be agreed between the engineer, erection and civil works contractors and the agreed programme shall then be mutually binding on Contractors for Civil / Mechanical / Electrical & PEB Erection.

2. Insurance

- a. The Contractor shall indemnify the Owner and every member, Officer, and Employee thereof and the Engineer and the Engineer's Agents and Representative and every member of his staff from any claim or demand from accident, injury,

damage, loss and/or compensation of any kind whatsoever arising out of or in connection with all claims and demands which may be made against the Owner or the Engineer for or in respect of or arising out of failure by the Contractor in the performance of his obligation under any of the provisions of the Contract. The Contractor shall take necessary insurance to protect himself against claim or demand.

- b. Without prejudice to his liability to indemnify the Owner under Article (a) of these Conditions, the Contractor shall maintain and shall cause any Sub- Contractor to maintain: -

Such insurances as are necessary to cover the liability of the Contractor or as the case may be of such Subcontractor, in respect of personal injuries or deaths arising out of or in the course of or caused by the carrying out of the work; and

Such insurances as may be specifically required by the Contract Bills in respect of injury or damage to property real or personal arising out of or in the course of or by reason of the Contractor or his Sub-Contractor carrying out the work, and caused by any negligence, omission or default of the Contractor, his servants or agents or, as the case may be of such Sub- Contractor, his servants or agents.

- c. The Contractor shall obtain and maintain a comprehensive all risk policy which should also cover insurance against loss or damage by fire, storm, tempest, lightning, flood, earthquake, aircraft or anything dropped there from, aerial objects, riot and civil commotion for the full value thereof all work executed and all unfixed materials and goods intended for, delivered to and placed on or adjacent to the work until Virtual Completion of the work. Should the Contractor make default in insuring or continuing to insure as aforesaid the Owner may himself insure against any risk with respect of which the default shall have occurred and deduct a sum equivalent to the amount paid by him in respect of premium from any monies due to or to become due to the Contractor.

3. Approval by the Owner / the Engineer

Any approval or any approval given with changes, by the Owner, Engineer or their representative shall not relieve the Contractor of any of its obligation, responsibility and liability for the safety, correctness and performance of the Works and his obligations hereunder.

4. Storage

It will be Contractor's responsibility to unload and store materials/Equipments properly. Storage of materials/Equipments received at site will be Contractor's responsibility. Contractor will be responsible for it till the handover of site.

5. Safety

- a. Workers required to work at higher elevations shall be provided with safety belts and shall be instructed not to work without wearing the Belt.
- b. Good quality safety helmets shall be provided to Workers posted at Site of operations and Contractor will take adequate measures to make usage of these helmets mandatory.
- c. Where there is danger of falling from a height exceeding 3.25 m., suitable precaution shall be taken to prevent the fall of persons or material. Suitable

- precautions shall also be taken to prevent persons being struck by articles, which might fall from scaffolds or other working places.
- d. In general, the Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with Owner's safety rules.
 - e. The Contractor shall adhere to all safety rules and regulations as indicated under attached OHS Manual.

Scope of Works

- a. Design, Supply, Packing & Forwarding of Machine/Equipment/Components.
- b. Unloading of Machine/Equipment/Components,
- c. Unpacking of machines/equipment/components packed parts,
- d. Shifting of all unpacked material/equipment/components to installation location place
- e. Assembling of all material machine parts/equipment/components parts
- f. Erection of all material machine/equipment/components.
- g. Achieve required levelling and alignment of machine/equipment/components.
- h. Commissioning & testing of installed machine/equipment/components.

SECTION – B: TECHNICAL SPECIFICATION FOR REFRIGERATION SYSTEM

Section- 1: Basis of Design

Table 1

Project Component	Capacity	Remarks
Frozen Store (- 20 Degree C)	2000 MT (675 MT X 3 NOS)	With pallet and rack system
Cold Storage (0 – 10 degree C)	5000 MT(1250MT X 4 NOS)	Designed for potato storage in bags on mezzanine floor structure
IQF	1 MT / Hr	Straight Flow Freezer , capacity based on green peas
Blast Freezer	1 MT / Hr	Based on mango pulp
Ante Room for Frozen Store(FR)	LS	Dimensions as per layout
Ante Room for Cold Store(CR)	LS	Dimensions as per layout
Packing Area	LS	Dimensions as per layout

Table 2

S r. No.	Room Description	Dimensions / Room (L x W x H)	Insulation Type	Insulation Thickness (W/C/F)	Designed Room Temperature	Designed Room Humidity (RH)	Product Loading per Day	Product Incoming Temperature	Product Final Temperature	Pull Down Time
1	Frozen Storage (3 Rooms)	20X 13X 8 M + 20X 15 X 8 M + 20 X 15 X 8 M	PIR	150/150/150	- 20	NA	6% OF THE TOTAL CAPACITY	-10	-20	24
2	Cold Storage (4 Rooms)	28.8X 21.8 X 8 M	PIR	150/100/100	0 - 10	60-90% USER DEFINED	10% OF THE TOTAL CAPACITY	25	0	24
3	IQF									
4	Blast Freezer	SUITABLE FOR 5MT PER BATCH	PIR	150/150/150	-40	NA	5MT/BATCH	35	-20	5-7 HRS
5	Ante Room (FR)	As per layout	PIR	150/100/100	5	NA	5 people for movement	-20	--	--
6	Ante Room (CR)	As per layout	PIR	150/100/100	5	NA	5 people for movement	0	--	--
7	Packing Area	As per layout	PIR	150/100/100	20	NA	1 MT/Hr	-20	--	--

Please submit all heat load calculations, selection of various equipments. Equipment layout plan

Section- 2: REFRIGERATION SYSTEM

1. REFRIGERATION COMPRESSORS:

Heavy-duty industrial refrigeration compressor working on Ammonia multi-cylinder with water cooled /air cooled head type complete with the following accessories.

- a) Suction and delivery stop valves.
- b) High and low oil pressure gauges with isolating valves.
- c) High and low oil pressure cutouts.
- d) Drive set including compressor fly-wheel, motor pulley and V belts.
- e) Set of tools, gaskets and foundation bolts.
- f) Automatic capacity control.
- g) Oil separators with oil return arrangement.
- h) Compressor base frame with foundation bolts.
- i) Control panel for housing pressure gauges, cutouts, etc to be mounted near the compressor.

2. ELECTRICAL MOTORS:

Horizontal foot mounted, TEFC squirrel cage induction motor with class 'F' insulation suitable for 3 phase, 50 C/s, 415 Volts \pm 5 % A.C. supply. The motor shall conform to IE2 high efficiency type conforming to IS 12615-2011. The motor shall be VFD compatible. Size of the motor shall be as given in the BOQ/ as recommended by the compressor mfg.

3. EVAPORATIVE CONDENSERS:

The condenser shall be of induced draft type/ forced draft type as, as specified below, suitable for ammonia and designed for continuous heavy duty operation. The condenser shall be complete with SS water sump tank as specified below.

The Condenser shall be complete with the following:

- a. Coil section with condenser coil made from the following as specified:
 - (a) Max 20 / 25 mm OD x min 1 mm thick S.S. 304 tube The coil will be split into two sections for ease of maintenance. The vertical spacing in the pipes shall be such that adequate clearance (around 50mm) is available for cleaning of the pipes manually.
- b. Fan section with 2/3 Nos. tube axial type fans with cast aluminum or S.S. / GRP impellers in aerofoil design. The fan motors shall be KIRLOSKAR/ CROMPTON/SIEMENS/ EQVT MAKE, TEFC squirrel cage with class 'F' insulation and IP 55 Protection and suitable for hot and humid air stream. The motors shall be suitable for 415 V, 3 phase, 50 C/s, A.C. supply. The fans shall be provided with guards made of S.S. material.
- c. The water sump tank shall be made of 2 mm S.S 304 Sheets duly coated with two coats of epoxy paints as specified. The tank shall be provided with water outlet connection, quick fill and make up connection, drain and overflow connection. The water spray arrangement shall incorporate G.I. 'B' class water spray header and nozzles of synthetic material designed for Heavy duty operation. Eliminators of efficient design made of 0.8 mm G.I or PVC fill shall be incorporated in the fan section. Air inlet section shall be provided with removable louvers made of G.S. sheet / PVC.
- d. The unit casing shall have removable panels made from 1.6 mm G.S sheet and the structural steel shall be hot dip/ spray galvanized. The unit shall be finally

painted with two coats of zinc rich / aluminum paint. The casing shall be designed for leak proof operation. Openable type inspection windows shall be provided on two longer sides with rubber gaskets between the water header and the coil section.

- e. Ancillary items such as float valve for make-up water, removable strainer for water outlet etc.
- f. Cleaning brushes for the condenser tubes cleaning (2 sets for each condenser) shall be provided.

4. H.P.RECEIVERS

Horizontal liquid receivers suitable for Ammonia made out of boiler quality steel plates, conforming to IS-516 Grade 70. Welding joints shall be radio graphed up to 10% as per International standard. The receiver shall be complete with the following:

- a) Liquid inlet and outlet connection.
- b) Safety valve connection with safety valve.
- c) Purge valve connection.
- d) Pressure gauge connection.
- e) Reflex type level gauge.
- f) Oil, drain connection with oil sump.
- g) 'L' type stands for receiver etc. (min 450 mm height)

5. INTERCOOLERS:

Vertical floor mounting type intercooler for interstage gas cooling and liquid sub-cooling. The intercooler shall be made of boiler quality steel plates, conforming to SA-516, Grade 70. The intercooler shall be complete with:

- a. Inter stage gas inlet & outlet connection
- b. Liquid inlet, liquid and gas connection for float switch
- c. Oil drain connection
- d. Liquid cooling coil of Tata 'C' class / ASTM A106 Gr. B
M.S. pipe - schedule 80
- e. Supporting legs

6. Horizontal L.P Accumulator Setup:

Horizontal ammonia accumulators for the liquid pump circulation system. The accumulator shall be suitable for the specified plant capacity. The LP Accumulator shall be made of boiler quality steel plates, conforming to SA-516, Grade 70. The material of construction of various connections of Receiver shall be confirming to relevant standards. The L.P. Receiver shall be complete with:

- a. Liquid outlet and gas inlet connections.
- b. Liquid in feed connection.
- c. Stand pipe 100 mm dia with connections for liquid level control etc., with provision for fitting isolating valves.
- d. Oil sump with oil drain connection, at the bottom of stand pipe size 200 dia x 500 mm long
- e. Safety, purge / pressure gauge connections
- f. Supporting structural framework for mounting receiver and ammonia pumps with operational platform and access ladder.

7. REFRIGERANT PUMPS:

Semi-hermetic type, Refrigerant circulation pumps for ammonia, for operation of 415 V, 3 phase, 50 C/s AC supply IP 54 protection. The pump shall be supplied with the following accessories:

- a. Flanges and counter flanges.
- b. Suction strainer & stop valve.
- c. Stop / Non return valve for discharge side.
- d. Stop valve for pressure gauge and connection for degassing pipe.

8. AIR COOLING UNITS (AMMONIA):

- Unit Type – Floor Mounted / Ceiling suspended type, as specified, designed for continuous operation and for ammonia refrigerant. The unit shall be generally made in three sections:
 - a. Coil section with drain pan.
 - b. Fans
 - c. Accumulator if required.
- The unit shall be designed for gravity feed / pump circulation / EEV feed as specified.
- Unit casing -- made from 1.6 mm thick. G.S. sheet duly painted with zinc rich paint. Drain pan --1.6 mm S.S. / 2mm M.S sheets duly galvanized & powder coated.
- The pan shall be suitably insulated and provided with heat tracing arrangement in case of sub-zero application. The Drain Pan shall have proper slope with liberally sized drain outlets.
- Evaporator Coil -- Designed for gravity feed / pump feed on ammonia as specified. The coil shall be made from materials as per one of the following alternatives as specified in table below:
 - 16mm OD x 0.5 mm thick / 20 mm OD x1.25 mm thick S.S. 304 tubes with aluminum plate type fins fitted with proper bonding mechanism.
 - The coils shall be pneumatically pressure tested at 25 kg / sq. cm.
- Accumulator -- Vertical type with stand pipe & connections for float switch, oil drain etc. for gravity feed units. The accumulator shall be suitable for single unit or twin type unit as specified.
- Fans -- Made of cast aluminum / S.S / G.R.P / P.I.G adjustable blades in aerofoil design with variable pitch. The fans shall be statically and dynamically balanced and shall have adjustable vertical louvers or fan guards in SS Construction. The fan motors shall be SIMENS/ KIRLOSKAR or equivalent Approved Make, TEFC squirrel cage type with Class 'F' insulation, suitable for operation on 415 volts, 50 C/s A.C supply. The motor shall be suitable low temperature application as specified. Fan peripheral heaters to be provided in case of sub-zero temperature application. The Fans shall be suitable for VFD connection for controlling motor speed.
- Defrosting -- Defrosting system shall be water / hot gas / electric as specified. Water defrosting system shall have a tray made of 1.6 mm G.S sheet over the coil with rows of 6 mm holes over the coil rows. The water supply header of G.I. 'B' class pipe with nipples for uniform distribution of water shall be provided.
- Hot gas defrosting with hot gas inlet connection etc. shall be provided, if specified.

- In case of electrical heating, the heaters shall have long and trouble-free life. Removable type flexible heaters shall be preferred. Heaters shall be supplied with humidistat, required cabling etc. to control the RH.
- VFDs if specified, shall be included (per ACU-1 nos.) along with choke, related cabling etc. as may be required.

9. AMMONIA PIPING, FITTINGS & VALVES:

- Ammonia (refrigerant) piping, fittings and valves shall be provided as per the drawings approved by Consultants and as per the quantities required as given in tender.
- All the piping shall be as per following specifications:
 - Up to 40 NB : Black Steel conforming to ASTM A-106 Schedule 80, Grade B Seamless
 - 50 NB & larger Black Steel conforming to ASTM A-53 Schedule 40, Grade B – Tata 'C' class ERW pipe
 - All liquid lines of pumping system shall all be seamless (Up to 40 NB: Black Steel conforming to ASTM A-106 Schedule 80, Grade B seamless and 50 NB & larger: Black Steel conforming to ASTM A-106 Schedule 40, Grade B seamless) irrespective of the requirement given above.
- JOINTS:
 - Up to 20 NB: May be serviced with proper jointing compound.
 - 20 NB & larger: Welded joints made by certified welders for pressure piping systems.
 - Flanged joints shall be used where necessary for normal maintenance & where required to isolate equipments.
- Flanges & fittings shall be standard Refrigerant fittings / wrought (forged) carbon steel. All flanges, elbows, bends, tees, or other pipe fittings shall be included as a part of left piping.
- All material required for supporting non insulated & insulated Refrigerant piping shall be enclosed in the scope of Refrigerant piping.
- The valves up to 15 NB size shall be screwed type provided with weldable flanges and counter flanges of approved make. The strainers shall have steel body with removable SS screen.
- All the refrigeration piping shall be thoroughly cleaned internally before installation.
- All the pipe supports shall be of M.S construction duly painted with anti-corrosive paint. Extra support shall be provided for supporting valves and other heavy fittings. Suitable clamps with rubber pads shall be provided with vertical risers. For pipe passing through walls. Suitable larger sized sleeves shall be provided. All the piping shall be pressure tested pneumatically at pr. 25 Kg/cm².
- All the M.S piping and valves etc. shall be painted as per the std. color codes. Fittings of accessories such as gauge, thermometer shall be included in the scope of work.
- Access ladders for the valve setups from catwalk shall be included in the piping cost.

- Support for the refrigeration piping shall be taken care of by the refrigeration contractor. Primary supports shall be provided by the PEB contractors which are typically at the roof or wall level. Further supporting to be done by refrigeration contractor. It is expected that the refrigeration contractor takes into account the drawings and makes himself aware of the supports being provided by the PEB or civil contractor and then prepare pricing accordingly.

10. WATER PIPING, FITTINGS AND VALVES:

- The piping shall be of Tata or equivalent make duly approved by the consultant.
- All the piping up to 50mm shall be G.I. 'B' class as per relevant IS specification and from 65mm onwards 'C' class. M.S. pipe as per IS-1239 specifications.
- Adequate number of flanges/ unions shall be provided in the piping for proper maintenance.
- The valves shall be Butterfly type and have cast iron construction body and disc. These valves shall be flanged type. The check valves shall be of swing type and shall have cast iron body and disc. The valves would be of approved make.
- All the pipe supports shall be of M.S construction duly painted anti-corrosive paint. Extra supports shall be provided for supporting valves and other fittings. Suitable clamps with rubber pads shall be provided with vertical risers. For pipes passing through walls suitable larger sized sleeves shall be provided wherever necessary.
- The piping shall be pressure tested. Hydraulically at a pressure of 7 Kg/cm² or 1.5 times the maximum pressure whichever is higher for 24 hours.
- All the M.S. / G.I. pipes shall painted as per standard color code.
- The piping is to be done, as per the layout drawings approved by the consultants. The working drawings shall have to be made by the contractor. The quantities are to be estimated as per the layouts given in the tender.

11. THERMAL INSULATION FOR PIPING, VESSELS ETC:

- (i) Fixing PUF or equivalent insulation over suction, liquid line piping including finishing with polythene sheet vapour barrier and 0.8 mm aluminum sheet cladding secured with S.S. bands, as per Table 'D' of BOQ.
- (ii) Insulation of accumulators / intercoolers / other vessels with PUF or equivalent material finished as per Item (i) above
- (iii) Insulation of small pipes, fittings and valves with 50 / 25 mm thick Nitrile Rubber / EPDM insulation based on whether the room temperature is low (-)20 deg C or medium (0-10 deg C).
- (iv) Insulation of drain pipes with 19 mm Nitrile Rubber / EPDM insulation.
- (v) Insulation of Refrigeration Valve with flexible material with suitable cladding with proper holding to the valve body. The insulation shall be suitable for removable & refitting during maintenance.
- (vi) Insulation of small pipes, fittings and valves with Nitrile Rubber / EPDM insulation covered with factory fitted Al foil cladding.

- (vii) Insulation of drain pipes with Nitrile Rubber / EPDM insulation with factory fitted Al foil cladding. Heat tracers for the pipe portion inside the chamber shall be provided.

The make of Thermal Insulation Shall be subject to approval by consultants.

12. ELECTRICAL WORK FOR REFRIGERATION SYSTEM:

- **MCC PANEL:**

- o Main MCC Panel MCC panel shall be free standing floor mounting, compartmentalized and modular in construction, fabricated out of 14/16 gauge CRCA sheet steel duly pretreated and painted with 2 coats of synthetic enamel paint.
- o MCC shall have separate incomer section with door interlock and isolated bus- bar chamber. Bakelite/ acrylic shrouds with danger labels shall be provided as required to cover live parts and bus-bars for safety purpose.
- o Separate cable- alleys shall be provided.
- o Cable entry shall be from top.
- o Aluminum anodized labels shall be provided for components and feeders. 32 x 6 mm copper earth bus bar shall be provided along panel length.
- o Necessary pedestal / mounting structure, sheet metal blanking covers, foundation bolts and all required material / accessories etc. shall be included Vendor shall submit detailed SLD, G.A. & dimensional drawings, BOM and wiring diagram for Owner's approval. MCC shall be manufactured and tested in an approved manner as per IS: 8623 and other applicable standards as per specs. given above.
- o The MCC panel shall have incomer / outgoing feeders etc. as described in the BOQ.
- o The MCC panel shall have Energy meter installed to measure the electrical power consumption by the refrigeration system

- **Power & Control Cabling:**

- o 1.1 KV grade PVC insulated , PVC sheathed, Al / Cu conductor, armored cables as per IS : 1554 , to be laid in excavated trenches , readymade cable trenches, cable trays, on wall / structure with necessary dressing clamping, cleating, tagging etc. including termination.
- o Cable selection as per good engineering practices, generally as per, but not limited to the following sizes:
 - a) 3C x 70 sq. mm - Aluminium
 - b) 3C x 50 sq. mm - Aluminium
 - c) 3C x 35 sq. mm - Aluminium
 - d) 4C x 4 sq.mm - copper
 - e) 3C x 2.5 sq.mm - copper
 - f) 4C x 2.5 sq.mm - copper
 - g) 2C x 1.5 sq.mm - copper
 - h) 3C x 1.5 sq.mm - copper
 - i) 4C x 1.5 sq.mm – copper

- **LT cable termination:**

- o LT cable termination using heavy duty tinned copper lugs, brass nickel plated double compression cable glands, PVC tape, PVC sleeves etc. selection as per good engineering practices, generally as per, but not limited to the following sizes :
 - a) 3C x 70 sq. mm - Aluminium
 - b) 3C x 50 sq. mm - Aluminium
 - c) 3C x 35 sq. mm - Aluminium
 - d) 4C x 4 sq.mm - copper
 - e) 3C x 2.5 sq.mm - copper
 - f) 4C x 2.5 sq.mm - copper
 - g) 2C x 1.5 sq.mm - copper
 - h) 3C x 1.5 sq.mm – copper
 - i) 4C x 1.5 sq.mm – copper

- **Cable Trays:**

- o 14 gauge GI perforated trays with galvanizing as per IS: 2629, IS: 4759 etc. to be mounted in trenches, wall, beam, structure etc. including steel supports as per site conditions.
 - a) 300 mm,
 - b) 200 mm,
 - c) 100 mm,
 - d) 50 mm

- **Earthing:**

- o Earthing as per IS : 3043 using conductors of following sizes inclusive of brazing, welding, jointing, clamping, hardware, bituminous paint at joints, connection to equipment and all required material, to be laid in outdoor trench at a depth of minimum 600mm, indoor in conduit, trays or on floor / wall / ceiling / roof / structure etc. with clamping at 500mm intervals.
- o All electrical panels, lighting panels, crane rails , tracks , metal piping, conduits, cable trays etc. shall be earthed at two ladders, handrails etc. shall be earthed using single earth conductor bonded to each component with ends connected to two different points of the earth grid , Metallic sheaths , screens, armour of cables. Neutral connections and metallic conduits / pipes shall not be used for equipment earthing, generally as per, but not limited to the following sizes :
 - a) 40 x 6 GI strip,
 - b) 32 x 6 GI strip
 - c) 25 x 6 GI strip
 - d) 25 x 3 GI strip
 - e) 4 SWG GI wire
 - f) 8 SWG GI wire
 - g) 12 SWG GI wire
 - h) 14 SWG GI wire

13. PLC PANEL:

- Siemens/ Allen Bradly / Equivalent make PLC having 512KB micro memory which shall be configured for following approximate inputs depending on system

configuration, Redundancy required only for power supply units(CPU and communication Redundancy not required)

- Digital Input
 - Digital Output
 - Analog Input
 - Analog Output
 - Modbus communication card for Remote monitoring, Viz. DCS.
 - PLC & SCADA software
 - PC with 19" LCD Monitor for SCADA (configuration of the PC shall be as per recommendation by SCADA software package contractor)
- PLC is for control & monitoring of entire Refrigeration plant with Graphical HMI. PLC shall be with Analogue/Digital Input, output cards as specified above.
 - PLC shall view all process parameters viz. compressor suction/discharge/oil pressures, Room Temperatures /RH, action of all sol valves etc.
 - PLC shall control following but not limited to: Room temperature with provision of suitable temperature sensors (Adequate nos. of temp. sensors shall be provided in each chamber)
 - It shall also control Liquid Level of LP Receivers (Accumulator) and Defrost control. HMI shall indicate status of all motors, Real time process parameters, alarms etc.
 - It shall have provision for Alarm History of last one month.
 - Provision shall be made to operate the Refrigeration plant manually or automatically.
 - PLC panel shall be made out of 14/16G CRCA sheet. It shall have suitable rating redundant PSU/MCB/Relays/Terminals etc.
 - The cost should include related power & control wiring. Internal wiring shall be of 1.5mm² for control and 2.5mm² for power. Cable entry shall be from top. It shall have provision for external earthing with one Cu/Al electrical and one electronic bus bar.

SYSTEM INTEGRATION

ALL COMPRESSORS, AMMONIA PUMPS EVAP CONDENSERS, PUMPS AND AMMONIA SAFETY SYSTEMS TO BE CONNECTED TO MAIN PLC WITH CONTROL AND DATA ACQUISITION.

SAFETY PLC SYSTEM CONNECTED TO ALL PRESSURE RELIEF VALVES, PPM SENSORS AT LEAST 42 NOS, WITH PRESSURE VENTILLATION SYSTEMS TO BE INCORPORATED FOR ACCIDENT CONTROL

CAPABLE OF HOOKING INTO A MAIN FIRE SAFETY BMS CONTROL PANEL PROVIDED BY US.

14. SAMPLE INDEX FOR OPERATION & MAINTENANCE MANUAL:

INDEX

Description No.	Page
1. Title of the project	
2. Index	
3. Basic Operations	
4. Basis of Design of the Project	
5. Operating instructions	
6. Make & serial numbers of all equipments	
7. Do's & Don'ts	
8. Operating System (Individual Equipments Mfg. manuals)	
9. Inspection & Routine Maintenance	
10. Trouble Shooting Chart	
11. Technical Specifications	
12. Test Certificate / valid calibration certificates	
13. Electrical Diagrams	
14. P & I and water flow Diagrams	
15. Service	
16. Warranty Certificates	
17. Purchase details	
18. As built drawings	
19. Site Photos	
20. Any other relevant points	

15. GENERAL CONSIDERATIONS ABOUT REFRIGERATION

- Standby compressors with motors to be provided.
- All safety gas masks and ammonia relief systems to be taken into account
- All electrical panels IP56.
- All negative temperature rooms to have silicon cables only
- All power cables type FLRS.
- Cable tray to be estimated.
- Pipe rack for pipe suspensions will be provided by us
- Please quote all spares and AMC for 3 years
- Please quote for plant operation and maintenance for the first , second and third year
- Please mention exclusions clearly. If you fail to mention specifically it will be deemed to have been considered as your supply , installation and commissioning scope
- Validation of facility will have to be done with and without load.
- Water and power will be given at a single point along with earthing
- All electrical panels whatsoever has to be provided by the contractor
- Please mention makes in the tender offer
- Test certificates namely DQ, IQ and PQ has to be provided by you before signing the contract

SECTION – C: TECHNICAL SEPCIFICATION FOR INSTALLATION & COMMISSIONING

1.0 Mechanical Installation

The Installation work would comprise

- a) General installation i.e. positioning and installing all the processing, miscellaneous and service equipment as per approved layout drawings and as per the contract.
- b) Supply and installation of structural supports/ platforms /access ladders.
- c) Supply and installation of service and product piping including ancillary items.
- d) Insulation and cladding of piping and equipment including supply of materials.
- e) Interconnections of services and electrical with equipment.
- f) Guide line for expansion work.
- g) Clean up of work site.
- h) Testing, commissioning and start-up.
- i) Painting including supply of paints as per standard codes.
- j) Training of personnel.

Detailed specifications are given in the subsequent clauses.

2.0 General installation

2.1 Positioning of equipment

The work involves preparation of access for moving of the plant and equipment including their fittings from the work site godown or from the place within the site where they have been unloaded, to the place of erection, decarting and placing on the foundation wherever required. All the civil foundations as per the manufacturer/contractor's drawings shall be arranged by the civil contractor. Foundation drawings for different equipments shall be submitted by the contractor as early as possible. The contractor shall supply the foundation bolts of different equipment foundation to the civil contractor. The contractor shall place the equipment and carry out final adjustment of the foundations including alignment and dressing of foundation surface, embedding and grouting of anchor bolts and bed plates. The contractor shall be responsible for obtaining correct reference lines for purpose of fixing the alignment of various equipment from master benchmarks provided by the owner.

Tolerances shall be as specified in equipment manufacturers drawings. No equipment shall be permanently bolted down to foundations or structure until the alignment has been checked by the contractor and witnessed by the purchaser. The contractor shall carry out minor alterations in the anchor bolts, pockets etc., at no extra cost and set the equipment properly as per approved layout, drawings and manufacturer's instructions. The contractor shall supply all the necessary foundation/anchor bolts and bedplates if required without extra cost.

The contractor shall supply, fix and maintain, at his own cost, during the erection work, all the necessary centering, scaffolding, staging required not only for proper execution and protection of the said work, but also for protection of the surrounding plant and equipment. The contractor shall take out and remove any or all such centering, scaffolding, staging planking etc., as occasion shall require or when ordered to do so and shall fully rein-state and make good all things disturbed during execution of the work, to the satisfaction of the owner. The contractor shall be paid no additional amount for the above.

3.0 Service Piping Installation

3.1 General guidelines

All piping systems shall comply with the latest editions of the following regulations wherever applicable.

- 3.1.1 Regulations of explosives inspectorate.
- 3.1.2 All applicable Indian standards:
- 3.1.3 All applicable state Government/central Government laws/acts.
- 3.1.4 The contractor to prepare all erection drawings of the proposed plant including equipment positions and service-piping positions (Isometric), spacing between pipes, all other relevant details and submit these drawings for approval.

3.2 Scope of Supply

The contractor shall supply all piping materials like pipes, fittings, flanges measuring instruments and all other items as shown in the flow diagram/specifications and schedule of quantities. All the pipe and fittings and insulation material etc. should be of class and make as approved by the owner. Prior approval of the owner must be obtained by the contractor for the class and make of all materials. The contractor should furnish the details of makes selected by him, in the proforma given in BOQ document.

3.3 Scope of piping erection

This to be performed by the contractor as outlined below:

- a. The scope of erection for piping, includes all system covered in the flow diagrams and specifications.
- b. The contractor's work commences/terminates at the pipe connections with valves or flanges as specified in flow diagrams/battery limits.
- c. The contractor shall also install necessary piping and any specialties furnished with or for equipment such as relief valves, built-in-pass and other items of this type.
- d. The contractor shall install primary elements for flow measurements, control valves and on-line metering equipment.
- e. The contractor shall perform necessary internal machining of pipes for installing orifices, flow nozzles, control valves etc.
- f. The contractor shall install all pipes, valves and specialties being procured from other sources (if applicable).

3.4 OTHER GUIDELINES

- a. Color code shall be used to identify pipe material. The contractor shall be able to identify pipe material. The contractor shall be able to identify on request all random piping prior to field fabrication.
- b. The contractor shall be responsible for quality of welding done by them and shall conduct tests to determine suitability of welding procedure by him. Finished welds shall be visually inspected for parallel and axial misalignment of the work, cracks, inadequate penetration, unrepaired burn-through, dimensions, and other surface defects, and it shall present a neat workman like appearance.
- c. All piping supports, guides, anchors, fasteners, hangers, rollers with structural framework shall be supplied and erected by the contractor. Only anchor fasteners of adequate size shall be provided for support from RCC structures and Hilmit Gun shall be used for fastening the anchors. The kind of pipe supports like GI clamps, wooden saddles, roller supports and support framework shall be as per design approved by the consultants & owner prior to taking up the work.

- d. All piping shall be suspended, guided and anchored with due regard to general requirements and to avoid interference with other pipes, hangers, electrical conduits and their supports, structural members and equipment and to accommodate insulation and conform to buildings structural limitations. It is the responsibility to the piping contractor to avoid all interference while locating hangers and supports.
- e. Anchors and/or guides for pipelines or for other purposes shall be furnished, when specified, for holding the pipeline in position for alignment. Hangers shall be designed fabricated and assembled in such a manner that they do not disengage by any movement of the support pipes.
- f. All piping shall be wire brushed and purged with air blast to remove all rust, mill scale from inner surface. The method of cleaning shall be such that no material is left on the inner or outer surfaces, which will affect the serviceability of the pipes.
- g. Pipe support shall be of steel, adjustable for height and primer coated with rust preventive paints and finish coated with dark admiral grey of approved shade. Where pipes and clamps are of dissimilar material, gaskets shall be provided in between. Rubber gasket of suitable for low temperature application & regular rubber gasket for positive temperature application.

Spacing of pipe supports shall not exceed the following:

Pipe sizes	Spacing between supports
Up to 12mm	1.5m
15 to 25mm	2.0m
30 to 150mm	2.0m
Over 150mm	2.5m

- h. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor slab by clamps or collars attached to pipe and with a 15mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at a lower point and air vent at the highest point. Flashing shall be of 0.6 mm thick PCGI flashing along with suitable waterproofing compound.
- i. Pipe sleeves at least 3mm thick, 50mm/100mm larger in diameter than the pipes shall be provided wherever pipe passes through walls and slabs. Annular space shall be filled with fiberglass and finished with retainer rings. No extra payment shall be made on account of providing the sleeves.
- j. All piping works shall be carried out in a workman like manner, causing minimum disturbance to the services, buildings, roads and structures. The entire piping work shall be organized, in consultation with other agencies work, so that the laying of pipe support, pipes and pressure testing for each area shall be carried out in one stretch.
- k. Cutout details in floors and slabs for installing various pipes are to be provided by the contractor immediately after receipt of the purchase order.
- l. The contractor shall make sure that clamps, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes include expansion joints wherever required.
- m. All pipes shall be accurately cut to the required size in accordance with the relevant BIS code and blurs removed before its laying. Open ends of the piping shall be temporarily closed as pipe is installed to avoid entrance of foreign matters. Where reducers are to

be made in horizontal runs, eccentric reducers shall be used for piping to drain fully. In other locations, concentric reducers may be used.

- n. Tee-off connections shall be through equal or reducing tees. Otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

4.0 Codes & Standards:

a) Safety in Mechanical Refrigeration

1.	Safety Code for Mechanical Refrigeration	IS 660 – 1963 (Revised) / ASHRAE 15 - 2001
2.	Equipment Design and Installation of Ammonia Mechanical refrigeration Systems	ANSI / IIR 2 - 2014
3.	Ammonia Compressor Units	ANSI/ARI 510 - 1993

b) Piping Systems / Equipments

1.	Refrigeration Piping	ASME/ANSI B 31.5 – 1992/ IIR 2 - 2014
2.	Copper Tubes for Refrigeration & Air-conditioning	IS 10773
3.	Mild Steel Tubes and fittings	IS 1239
4.	Seamless Carbon Steel Pipes	ASTM A106
5.	Seamless & Welded Black / Hot dip zinc coated pipes.	ASTM A53
6.	Seamless & Welded Steel pipe for low temperature services	ASTM A333

c) Pressure Vessels

1.	Refrigerant Liquid Receivers	ANSI / ARI 495- 1999
2.	Water-cooled Condensers	ARI 450 – 2007
3.	Air-cooled Condensers	ARI 460 – 2005
4.	Evaporative Condensers	ARI 490 – 2003
5.	Unit coolers (ACUs) for Refrigeration	ARI 420 – 2000

5.0 Insulation of piping and equipment

- 5.1 Shall be carried out as specified below in refrigeration specification point no. 11.

6.0 Interconnections of Service and Electricals with Equipment

- 6.1 The contractor shall lay service piping and provide connections with the equipment complying strictly with the equipment manufacturer's instructions. The contractor shall also carry out all the interconnecting service piping with the various items of plant/system. The work shall be complete with capillary piping if required and connections with instruments and controls supplied with the equipment.
- 6.2 The contractor shall also carry out electrical connections for equipment with the control panels including equipment lighting as per the wiring diagrams of the equipment contractors. Connection shall be made for small electrically operated devices on equipment installed as accessories to, or assembled with equipment. Connections regarding instruments, float switches, limit switches, pressure switches, thermostats and other miscellaneous equipment shall be done as per manufacturer's drawings and

instructions.

8.0 Guidelines for Expansion Work

8.1 Cleanliness - Whenever the contractor is required to work in existing plant area, he should take due care and extra precautions to ensure absolute cleanliness and minimum hindrance for proper working of the existing plant.

9.0 Clean-up of Works Site

9.1 All soils, filth or other matters of an offensive nature taken out of any trench, drain or other places shall not be deposited on the surfaces, but shall at once be carted away by the contractor from the site of work for proper disposal.

9.2 The contractor shall not store or place the equipment, materials or erection tools on the drive ways and passages and shall take care that his work in no way restricts or impedes traffic or passage of men and materials during erection. The contractor shall without any additional payment, at all times keep the working and storage area used by him free from accumulation of dust or combustible materials, waste materials rubbish packing, wooden planks to avoid fire hazards and hindrance to other works.

9.3 If the contractor fails to comply with these requirements in spite of written instruction from the owner, the owner will proceed to clear these areas and the expenses incurred by the owner in this regard shall be payable by the contractor. Before completion of the work, the contractor shall remove or dispose off in a satisfactory manner all scaffolding, temporary structures, waste and debris and leave the premises in a condition satisfactory to the owner. Any packing materials received with the equipment shall remain as the property of the owner and may be used by the contractor on payment of standard charges to the owner and with prior approval of the owner. At the completion of his work and before final payment, the contractor shall remove and shall restore the site to neat workman like conditions at his cost.

10.0 Testing, Commissioning and Start-up:

10.1 The contractor shall operate, maintain and give satisfactory trial run of the plant in such manner and for such periods as has been specified. Following are the pre-commissioning activities to be carried out by refrigeration contractor before commissioning of the plant.

A. Pressure Test-

Test should be carried out for a minimum of 24 hours to identify the leakages in the system. The refrigerant system and the circuit shall be pressure tested with nitrogen gas / air to test pressure of 21 kg/cm² on high side & of 12 kg/cm² on low side. Subsequent to completion of the test, a proper Test Certificate should be furnished.

B. Vacuum Test –

After pressure testing, the refrigeration system should be tested for vacuum at 600mm before charging the oil and refrigerant.

The system should then be kept under vacuum for 6 hours. If any loss in vacuum in the system after 6 hours period, it means there is a leakage in the system.

C. Electrical Tests

- i. Check motor nameplate voltage.
- ii. Check motor rotation and speed, prior to connection of the driven equipment.
- iii. Check for starting current & no load current of each motor.
- iv. Check the earth continuity loop resistance for every motor starter.
- v. Check the insulation to earth resistance for every motor starter taken with 500V

- “Megger” tester.
- vi. Test the full load current taken by all motors on each phase. (Only after commissioning)
- vii. Test the tripping time of starter overloads set to 10% above the motor nameplate rating.
- viii. Test the function of controls of each compressor unit. (E.g. selector switches correctly wired, high or low circuit cut-out operates, level switches correctly operating etc.)
- ix. Check motor temperature by running the motor for 4 hours on no load.

D. Air Flow in Cold Stores

Airflow tests shall commence as soon as fans are wired up. The quantity of air can be checked with the help of anemometer & air throw can also be checked.

E. Instruments

Required

Anemometer

Tong tester

Megger

Other required instruments

F. BALANCING REFRIGERANT CIRCUITS

It can be carried out at the time of commissioning of the system. Method of Balancing - The Contractor shall balance all circuits by operating the regulation valves/appropriate control devices/systems provided for the purpose. Fluid flow through the cooling and heating coils shall be adjusted wherever applicable.

G. SETTING AUTOMATIC CONTROLS AND INSTRUMENTATIONS SYSTEMS

- a. Operation of system on PLC to be carried out only after commissioning of the system in manual mode.
- b. Positioning of Sensors.
- c. Calibration of instruments.
- d. Records of settings/pressure-levels/positions of actuators, limits, etc.
- e. Alarm Testing Functional tests shall be carried out for control system of individual system.

H. COMPRESSOR TEST ON AIR

- a. Check foundation/base frame as per manufacturer’s recommendation (Ref. manual).
Check for sufficient curing for foundation.
- b. Check alignment of motor and compressor.
- c. Check to ensure there are no stresses on suction / delivery pipes of compressor.
Check for pipeline supports provided to avoid vibration on the compressor and plant.
- d. Provide a non-return valve as near as possible to the delivery stop valve in discharge pipeline to avoid back pressure on compressor and for easy restart of the compressor.
- e. Install the pressure gauges and safety cutouts board separately on stand and not on the compressor. Ensure proper and correct electrical connections and operation of these cutouts from electrical export.
- f. All system pipe lines before installing are to be ensured that they are cleaned / flushed thoroughly to avoid dirt entering in to compressor.

- g. Create vacuum on the entire system by two stage vacuum pump and hold for 24 hours without any rise. (Vacuum level up to 600 mm of HG vacuum)
- h. Charge fresh recommended refrigeration oil into the compressor to a 5/4th sight glass level
- i. Being a taper fitment of shaft and flywheel a responsible person should ensure for its correct fitment.
- j. Do not take oil return from oil separate to compressor directly for first 1000 hrs. For re-use check the drained oil, confirm its quality and then use only if filter is connected between separate and crankcase pipeline.
- k. To avoid scaling of compressor water jacket and condenser use proper chemicals for water treatment.
- l. If compressor are running in parallel gas / oil equaling connections are to be properly made.
- m. If KC compressor – Check for cloth bag filter in suction gas strainer for changing and remaking (Ref. Manual).

I. NH3 Charging & temperature pull down:

- a. All cold stores are to be cooled initially up to 15 Deg. C & further cooling to be done at the rate of 10 Deg. C per day. The produce to be loaded once the desired temp. is achieved.
- b. Log sheets needs to be recorded.

10.2 The commissioning shall also include the following for each equipment:

- Field disassembly and assembly of equipment, instruments and controls where required for access to fixing or adjustment.
- Clean out of lubrication system including chemical cleaning wherever required.
- Circulation of lubricant to check flow.
- Clean out and check out or all the service lines.
- Check out and commissioning of instruments, equipment and plants, they shall attain the required properties/standards, specified tests in this regard must be carried out by approved authorities and their satisfactory reports submitted to the owner before start-up.
- Recharging or make-up filling of lubricant oil up to the desired level in the lubrication system of individual machine.
- Operation in empty condition to check general operation details wherever required and wherever possible.
- Closed loop dynamic testing with water wherever required.
- Operation under load and gradual load increase to attain maximum rated output.
- Trouble shooting during the trial period.

10.3 The contractor shall demonstrate proper working of all mechanical and electrical controls; safety and protective device, in presence of the owner's engineer and the same should be duly recorded.

10.4 Commissioning of automation system:

The contractor should provide a detailed schedule of testing all automation and control systems. All controlled or monitoring devices on the plant should be tested from the relevant control center and recorded to be operating as designed, including feedback detection.

A log of these operations is to be maintained, and each completed group of tests to be signed by the contractor's commissioning engineer.

The purchaser reserves the right to witness as much of these test procedures, as he may feel necessary. Testing procedures and commissioning period will be as specified.

J. Painting

All the equipment/machineries like motors, pumps, LT panels, switch boards, starters, junction boxes, isolators, storage tanks, supporting structures, pipe supports and MS/GI pipes and all exposed and visible iron parts included in the scope of erection/commissioning shall be given double coat of oil based paint of approved shade over a double coat of anti-corrosive primer with 50 micron total thickness wherever necessary.

All surfaces wherever required, must be properly cleaned from scale, dirt and grease prior to painting. Spray painting must preferably be used on all the equipment/machineries and wherever practicable. Suitable and necessary cleaning/wiping of sight/dial glasses, other non-metallic parts, flooring, walls and other surfaces which have been spoiled by paint during painting must also be carried out by the contractor. Lettering and other markings, including capacity and flow direction markings, shall also be carried out by the contractor on the tanks, pipe lines, starters, motors, isolators and wherever else necessary, as directed and as per the standard practice of installation. ISI color codes and color charts as mentioned must be adhered to.

Supply of all paints and all other materials required is included in the scope of contractor under this contract/order.

K. Training of Personnel

Necessary staff as may be deputed by the owner shall be trained by the contractor for operating the plant. The personnel will be associated for the training during the installation, testing, commissioning and start-up period. This training will be a continuous process during commissioning and stand by period and as described in the technical specification.

Internal Lighting

Internal Lighting of the rooms shall be provided with suitable type CFL / LED fittings & necessary interconnecting cabling works & the light switch located conveniently near the door. All the light shall be provided with light covers. The quality shall be such to withstand environmental conditions maintained inside the room.

Control Systems

- All chambers must be equipped with digital display of required operational parameter like temperature, humidity, gaseous levels inside etc. Such displays should be located at convenient places outside the chamber and also at the main panel in the plant room.
- All chambers must be equipped with control systems to take care of operational parameters. They must be automated to arrest the fluctuations and should have self correction mechanism.
- Data loggers devise to be provided for each chamber, which can be linked to a computer output.

- All chambers must have independent operational controls in order to have capability of individual operation independent of other chambers and systems.

Any other specification requirement which is not being specifically mentioned as a part of this specification but required for smooth operation to deliver optimum performance of the system shall be considered and provided by the suppliers.

The overall system design shall conform to Technical Guidelines provided by National Horticulture Board for Cold Storages (with all the amendments) and standard provided by ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers).

Accepted Makes of Major Items

Description	Acceptable Makers
Insulated PUF Panels	Metecno / Rinac / Llyod
Insulated Doors	Metaflex / Rinac / MTH/INFRACA
Dock Door, Seal & Leveller	Shakti Horman / Spanker / Elite
Ammonia Reciprocating compressors	Kirloskar / Mycom
Ammonia Pumps	Hydrodyne / Hermetic / Witt
Air Cooling Units	Alfa Laval / Starcooler / Starcore/Thermofin
Chilled Water / Water Pumps	Kirloskar / Beacon/KSB
Freon Compressors	Bitzer / GEA / Frascold
Evaporative Condensers	Evapco / Baltimore / WXR/Starcooler/Starcore
Motors	ABB / BBL / Siemens
Valves	Danfoss / Parker/Dhiren/Manik
Pipes	Tata / Jindal / equivalent
Cables	Polycab / Universal / Finolex / equivalent