CHAPTER 2 - TECHNICAL & MATERIAL SPECIFICATION

2.1 Scope:

(a) This specification relates to supply and commissioning of adequate capacity of two ref plants with 100% redundancy per ship(01 working+ 01 standby) and for each of the 08Anti Submarine Warfare Shallow Water Craft (ASW SWC).The ref plant capacity is to be calculated by the vendor and to be approved by GRSE/IN.The equipment shall be suitable for marine applications and must achieve specified performance smoothly under tropical conditions.

(b) Firm shall be responsible in totality, on turn-key basis for undertaking detailed design, manufacturing, testing, packaging, supply (plant and its associated accessories),shipping in of all equipment, installation, alignment, setting to work, commissioning and test & trials, maintenance, operation-regular runningof Ref plants considering general and environmental specification of the ship given in chapter 1 and detail technical specification and scope of supply brought out in the subsequent chapters of this SOTR meeting the heat load requirement, noise, vibration and shock requirement, including associated auxiliary systems, as per this SOTR.Any other equipment/ items as considered essential for satisfactory operation of the system are to be supplied by firm.Any kind of dismantling and refitting required during shipping in of the equipment is to be carried out by OEM. The broad scope is elaborated below:

I. Dismantling of equipment's at yard for the purpose of shipping of items/parts on board ship.
II. Shipping of dismantled parts & other supplies to their installation location on board ship.
III. Re-assembling & Installation of equipment that aredismantled for shipping on board.
IV. Piping & cabling between various equipment placed at different compartments.
V. Integration of refrigeration plant with Air Coolers in Cold and Cool room& seawater pump.
VI. Hydro testing, vacuuming, gas charging & commissioning of plant.
VII. Performance test during HATS & SATS.
VIII. IPMS Integration at Refrigeration Equipment end.

(c) SBN, ABN & vibration trial as applicable shall be carried out during FAT. The limiting values for ABN and SBN to meet the platform values are indicated at Appendix 1 & 2.Compliance to meet the promulgated SBN and ABN values are to be to be submitted in the technical offer. All measurements of SBN and ABN are to be undertaken using the standard procedures as specified in MIL 740-2-SH and MIL 1474-E. The ABN & SBN measurements will be undertaken at 25%, 50%, 75% and 100% load.A penalty of 5% will be levied on the OEM if SBN & ABN limits are not met during FATs.

(d) Vendors shall attend following meeting at GRSE in regards of above.

I. **Pre-bid and TNC meeting:** A pre-bid meeting will be conducted at GRSE (Kolkata) with the prospective bidders within 14 working days from the publishing of tenders (prior submission of offer).Noncompliance to this SOTR, if any, shall be clearly brought out by the supplier in Pre-Bid meeting as well as in the technical offer OEM will also be required to attend TNC / CNC meetings at GRSE post submission of their technical bid, followed by PNC meeting at GRSE with selected vendor.

II. **Meeting post awarding of PO:** Selected OEM has to attend TECHNICAL/ PDRM/ CDRM/ interface meetings at GRSE (Kolkata) with GRSE and other OEMs of relevant equipment within 07 days of intimation.

2.2 Scope of Supply:

The list of equipment's to be supplied along with accessories &instruments are as follows:-

Sr. No.	Equipment	Quantity/Shipset
I.	Refrigeration Plant Unit including S & V Mounts & Holding Down Bolts.	2 Sets
II.	Sea water Pump including S & V Mounts & Holding Down Bolts	2 sets
III.	Receiver Tanks	2 Nos.
IV.	Air cooling Units(for cold room, Cool room) including S & V Mounts, & Holding Down Bolts, Channels/Supports/Low conductivity Block/Nut/bolts/washers etc (refer Appendix 5)	2 sets
V.	Filled Refrigerant Bottle of standard size of total capacity equal to one system Recharge	1 Set
VI.	Panels fitted with Push button for man locked Alarm	2 sets
VII.	PT 100, TT sensors for Refrigeration Compressor temp. and pressure Monitoring	2 sets each
VIII.	Starter Cum Control Panel for 2 nos refrigeration plant & seawater cooling pumps including S & V Mounts	1 Sets
IX.	First charge of refrigerant gas and lubricating oil	1 Set
X.	**Accessories. (Refer annexure 1)** a) All piping material, Bulkhead glands ,necessary Valves, instruments & accessories fitted for gas pipe line b) Instruments & accessories for Seawater system c) Insulation material for gas pipeline	1 Set
XI.	**Instruments**. Safety, control and monitoring devices are to be fitted on equipment as per requirement. All Miscellaneous items are to be fitted as per functional requirement of the system. Any other instruments & accessories not listed however is required for satisfactory operation refrigeration plant, pump as supplier design shall also be part of his offer.	1 Set(should suffice 1W +1 Standby ref plant, 1 Cold room & 1cool room

XII.	Pressure gauges with Protecting Cover for suction and discharge of the pump along with three way cocks	1 Set
XIII.	Oil Separator	2
XIV.	Retractable Ref Charging hose mounted on a portable hose reel with adaptors of min 20 meter length	1 sets

2.3 Applicable Standards:

The equipment should adhere to the latest Class rules as necessary. Also the following documentation or their latest issues in effect is to form a part of this specification to the extent specified herein, except where a specific issue is indicated. In case of a conflict between the contents of this document and the applicable portions of the referenced documents, the contents of this document shall take precedence.

Sr. No.	Standards	Specification
I.	NES 111	Requirements for the Construction, Fitting Out and Testing of Refrigeration Spaces
II.	NES 102	For AC / Ventilation habitability of surrounding compartments.
III.	NES 1004	Requirements for the design and testing of equipment to meet environmental conditions.
IV.	MIL-STD-167-1A,MIL-STD-167-2A	Mechanical vibrations of Shipboard equipment.
V. VI.	NES 723	Tally/diagram plates.
VII.	NES 1004	Requirements for the design and testing of Equipment to meet environmental conditions.
VIII.	DME Specs 405 (Rev-1)	Specifications for Bourdon type Pressure and Vacuum Gauges & Instrumentation specification.
IX.	DME Specs 424	Specifications for Electrical IndicatorInstrumentations
X.	DME Specs 452	Documentation specifications.
XI.	DGS 251	Painting
XII.	IS 13161 (Part 3) 1992 (Para 4)	Permissible Noise Levels in machinery related spaces
XIII.	BS 1400 LG4C	Requirements for Gun Metal castings and ingots
XIV.	NSS-II as per BR 3021	Requirements for High Impact Shock Tests - Shipboard Equipment and Systems
XV.	BS 6121/EN 624440-2013	Cable Glands
XVI.	EED-Q-71(R4)	Electrical specs for AC motors and control panels
XVII.	JSS 55555	Environmental Test methods for Electronic &

		Electrical Equipment.
XVIII.	MIL-STD-1474E,MIL-STD-740-2 (SH)	Airborne and Structure borne Noise measurements and acceptance criteria of shipboard Equipment
XIX.	DME 411	Specification for RTDs and Thermocouples
XX.	DME 303 D	Inspection specifications
XXI.	MIL-STD-461F	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
XXII.	ISO 10816	Mechanical vibrations of Shipboard equipment.
XXIII.	Def Stan 02-302	Requirements for maintenance envelopes and removal routes.
XXIV.	MIL-STD-1472G	Design criteria standard - Human engineering.
XXV.	INBR 622	Guidelines for Preparation of Ranged and Scaled allowance of spares for ship borne engineering equipment and systems.
XXVI.	DME spec 464	Design Guidelines for Bilge plates, elevated platforms & Gratings
XXVII.	NES 865 Issue 1	Guide to the selection, installation and maintenance of Noise reduced pipework system.
XXVIII.		
XXIX.	Def Stan 02-830	Requirements for Gun metal castings and ingots
XXX.		
XXXI.	Def Stan 02-329	Heat exchangers

2.4 <u>Technical Requirements:</u>

(a) Ref plantutilizing contemporary technology compressor viz. screw (open/ semi hermetic) or reciprocating catering to the ship's product load is to be provided under specified external environmental conditions as brought out in chapter 1.The complete requirement of meeting the heat load at sea in tropical condition should be met. The equipment shall be suitable for marine applications and must achieve specified performance smoothly under tropical conditions. Equipment shall withstand contamination through oil, salt and other contaminants associated with the marine environment. The equipment shall be water drip proof as a minimum requirement. The equipment is to be designed for continuous operation & survival under the environmental conditions as specified in chapter 1.The plant compressor should use R134A. Sea water pump and associated accessories (including bellows, counter flanges, fasteners etc.) with head and capacity corresponding to the Plants and SW water system are to be provided. The sea water pump to be cross linked with isolation valve to work with either of the compressors. The REF Plants are to be provided with a local control panel supplied by the firm catering for control and monitoring under all regimes of operation. Remote monitoring of the REF Plants shall be catered through IPMS.

(b) All Refrigeration Plants are to be supplied as a packaged, modularized plant dully fitted on a common rigid skid. Each refrigeration unit shall consist of Screw (Open/Semi-hermetic) or reciprocating type compressor driven by motor through direct/ flexible couplings along with control panels starters, oil separators, Fabricated Frame, shell and tube type condenser with accessories, receiver with accessories, dehydrator, solenoid valves, expansion valves, thermostats, pressure switches, pressure regulators, thermometers, pressure gauge, Pressure transmitters, Temperature transmitters unit coolers, refrigerant copper pipes, fittings, valves, strainers, driers, instrumentation, foundation bolts, eye bolts for lifting and first change of refrigerant gas and lubricating oil, common sea water pump along with actuator valve, Pressure reducing valve for emergency cooling system, and control system, **product coolers with fan/motor** with all interconnecting copper pipe, heaters and accessories (for each room). Each unit is to be capable of maintaining the stipulated temperature of all refrigerated compartments independently under all conditions of operation. One plant shall be capable of supporting both cold and cool rooms. Machinery must be safe to operate with adequate guard covers/safety devices/other such devices. The compressor is to be mounted on the top of the framework on Resilient Mounts providing easy access for maintenance tasks. Any other items, as required for satisfactory plant operation shall be provided.

(c) The refrigerating system shall be composed of two (02) separate refrigerating plants operating with refrigerant R-134a. Each of the two refrigerating plants should cater for 100% load. Built-in compartments (Table 1) to be served and to carry victuals as per provision as specified in table below. Safety release line with backlit liquid filled sight glasses are to be provided. All OEMs to submit the preliminary capacity calculations for the indicated complement during Pre-bid.

(d) Minimum Specification for Reference: -

I. Type of Unit : Refrigeration Plant
II. Cooling Capacity : approx. 4.2 KW(The actual capacity shall be decided by OEM based on product load as per NES111)
III. Provisions for calculating Product loads for Cold and Cool room: -
IV. Poultry and mutton – 30 days.(184 kg)
V. Veg and dairy – 15 days.(978 kg)
VI. No. of complements – 50 Sailors & 7 Officers
VII. Pull down time:~~48 hrs.~~ 24 hrs To be decided in Prebid Discussion.
VIII. Supply Voltage : 415 Volts, 3 Ph, 50Hz
IX. Refrigerant : R – 134a
X. Lubricating Oil : To be Specified by the Supplier.
XI. Initial product temperature(Veg & dairy): 10°C
XII. Initial product temperature Meat/fish :0°C.

1.

XIII. Design calculations shall be submitted by suppliers.
XIV. Veg Rm & diary room are to be treated as one compartment and a suitable product cooler is to be catered for the same. Firm to supply total 02

product Coolers for Cold and cool rooms. Firm decision for same shall be communicated in pre Bid

Table 1

Sl No	**Storage**	**Qty**	**Overall Size of the Room in MM.**	**Temp**
1	Cold room	01	(GA to be referred)	-18°C ± 1 degree centigrade.
2	Cool Room (Veg Room)	01	(GA to be referred)	3°C to 7°C
3	Dairy Room	01	(GA to be referred)	3°C to 7°C

(e) Insulation Plan for cold/cool room is as per NES 111.

(f) Separate –Seawater-cooling pump shall provide cooling water for the condensing unit ofthe Refrigeration plants. Emergency seawater cooling shall be provided by fire main/ auxiliary seawater cooling system/ Machinery Propulsion Plant cooling system as applicable.

(g) Temperature readings of the refrigerated compartment are to be displayed digitally outside the compartment and to be interfaced with ship IPMS for monitoring in Machinery Control Room. In case of a rise in temperature above the stipulated limit an alarm is to be provided in the Control Panel as well as in IPMS.

(h) Provision of manual call button from inside the cold/cool/dairy room compartments shall be provided with alarm on the control panel and IPMS. In addition to above, an audible alarm (hooter) in handling room and MCR shall also to be provided.

(i) Heaters are to be provided for defrosting including tape heaters for drain trays and over drain pipes for Air cooling Units of Cold and Cool room. Commencement and termination of the defrosting cycle is to be indicated on the local control panel as well as in the IPMS. Both auto & Manual defrosting control is to be provided.

(j) Independent Air Cooling units with evaporator coil and blower to maintain design temperature, temperature switches, heaters for drain tray, Temperature transmitters for cold and cool roomto be supplied along with shock mounts and mounting arrangements.

(k) The plant design should ensure high reliability, economy of power consumption, economy of weight / space with high mean time between overhauls and ease of maintenance and the configuration selected must meet intended service requirements confirming to Naval standard/ Class requirements, shock, the noise

and vibration requirement, including associated auxiliaries systems as per this SOTR.

(l) Design of piping systems for low noise levels shall be undertaken as per NES 865.

(m) Assembly& space constraints: The equipment is to be of modular design to facilitate easy dismantling, shipping, unshipping. The OEM is to indicate the dimension & weight of the largest component. The manufacturer is to indicate the minimum space requirement for operating the equipment as well as the maintenance envelope required to carry out maintenance onboard during normal operation and refit. Ease of operation and maintenance are to be ensured while designing the layout of REF Plant. The dimensions (not exceeding) of both the plant are to be limited within of available space of as in GA drawing. However, smaller in size shall be considered as better. Based upon the equipment binding design documentation, mechanical interfaces between equipment, operational/ maintainability requirements, Shipyard shall refine &finalize the layout of equipment, within respective compartments of the ship. The same shall be fully complied by the equipment supplier.

(n) Manning Policy :The machinery should be able to be controlled, monitored from local position and monitoring from remote position through IPMS. Electronic local control panels are to be included in the scope of supply and must be provided with instruction plates for start stop procedure. All control panels must be provided with necessary mounts to meet shock & vibration requirements stipulated in subsequent sections.

(o) Interchangeability: Interchange tolerance shall be such that all item parts having dimensions and characteristics permitted by the item specifications may be used as replacements without compromising equipment performance and shall be interchangeable between different units.

(p) Lifting Arrangement: All components weighting more than 40 kg are to be provided with provisions for fitment of eyebolts, where there is a danger of transit damage due to freedom of a dry rotor to move within its casing, a suitable jacking or rotor locking device is to be provided.

(q) Noise, Vibration & Zoning: The following standards are to be adhered to in respect of noise and vibrations for the equipment along with its accessories (as applicable) during their FATs / Harbor trials / Sea trials.

(r) Equipment Vibration - ISO 10816.
(s) Airborne Noise of Compartment - IS: 13161 (part 3)
(t) Eqpt Air Borne& Structure borne Noise –Will be provided by GRSE (Appendix–1 &Appendix 2).

(u) Noise Damping: The reduction of airborne and underwater noise and structural vibration caused by machinery shall be regarded as an essential part of the installation. As far as possible, the noise and vibration shall be reduced at source. Shock/AV mounts, flexible pipes (IRS approved type) etc. to be used for reduction of noise and vibration.

(v) Shock standards: Equipment and its associated auxiliaries/accessories/controls shall meet shock standards as per NSS II. When exposed to the specified shock condition, the equipment shall be operationally available without any time restriction, after exposure to shock. The preliminary shock calculations of the equipment duly vetted by a third party is to be submitted along with the technical offer. The procedure for shock testing is governed by *IN* shock policy vide EG/5522/Policy dated 11 May 07 and EG/Policy/TSV/13/2016 dated 13 Dec 16 (Refer Annexure B). If the equipment needs to undergo a physical shock iaw *IN* shock policy, the equipment has to be yellow banded and handed over to the *IN*.

(w) Vibration recording & Equipment health monitoring: Fixed positions for mounting portable accelerometers/sensors for measuring offline vibration, are to be provisioned (preferably by spot facing on equipment casing). The Offline vibration sensors are not in vendor's scope.

(x) EMI/EMC Standard: All equipment / systems being fitted onboard shall be MILSTD-461F compliant. Test plans and Test Reports shall be forwarded to NEC. COTS equipment shall comply with IEC 60945 or IEC 60533 or equivalent standards. Grounding, bonding and shielding as per MIL-STD-1310H.

(y) NBCD Requirement: INBR 312 to be complied (as applicable).

(z) Interfacing: The ref plant system shall be interfaced with ship's IPMS for control and monitoring. Detail of interfacing requirement is elaborated under Remote Control & Monitoring section. The firm shall ensure that REF Plant complete with refrigeration System is compatible for integration with other ship systems, electrical systems, structures of the ship. The vendor has to interact with IPMS vendor and shall provide all the information and data to IPMS vendor for successful integration of the plant with IPMS.

(aa) Weights: Total weight of the equipment shall be indicated in the technical offer as well as on the GA drawing. In order to achieve maximum economy in weights, careful attention should be given to every part of the machinery and system with a view to limit its final weight within ± 5% variation without prejudicing its reliability and efficiency. The manufacturer/supplier of the equipment shall indicate net weight on the packing case(s) and test report(s)/ Class/ DQA(WP)/GRSE QA/ Naval Inspecting Authorities reports which would be recorded. The inspection authorities should countersign all such weight certificates. Within six weeks of placement of order, accurate weights of parts of supply shall be supplied.

(bb) Material Specification: A component wise material specification of materials used for the construction of, heat exchangers, pump, internal piping systems, etc. are to be indicated in the proposal. Materials / components approved for use onboard Naval ships are only to be used. Any deviation from the material specified is to be indicated with reasons subject to condition that the material is fit for marine application.

(cc) Heat Exchangers: All Sea water heat exchangers external to the equipment shall conform to Def Stan 02-329.Cu-Ni shell and tube type suitable for operation in a marine environment. Zinc protectors are to be provided in end covers (as applicable). Heat exchangers sea water section are to be provided with filling point for flushing with fresh water. Def-Stan 02-329 to be followed in this regard.

(dd) Availability: The time required to bring the equipment to full operational use is not to exceed 5 mins,15 mints and 1 hour from daily, weekly and monthly preventive maintenance.