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TECHNICAL SPECIFICATION

Annexure 'A'

List of Deliverables: *for each set*

Sl. No.	Item	Qty
1.	AC Servo Amplifier with built in power supply as per annexure - 'A'	8
2.	AC Servo Motor with Brake. As per annexure - 'B'	8
3.	Encoder with coupling OCD-S101G-1416-S10S-PRL Make: Posital Absolute Encoder, connector for encoder will be supplied in loose.	8
4.	Interface panel with Auto Transformer	4
5.	Distribution Panel for the mains	2
6.	Supply of Manuals with Soft Copy as per Annexure 'C'	10 Sets each
<b>On board Spares</b>		
7.	AC Servo Amplifier with built in power supply as per annexure - 'A'	1
8.	AC Servo Motor with Brake. As per annexure - 'B'	2
9.	Encoder with coupling OCD-S101G-1416-S10S-PRL Make: Posital Absolute Encoder, connector for encoder will be supplied in loose.	4

1. **Interfacing:** The isolation distribution panel has to tap power supply of 415V 3 phase, and 50Hz; 230V, 24VDC from the ship system. The interface panel with drives has to obtain input from FCS (Fire control system) and give output to control elevating and training motors of SR and LRMR Launchers. The encoders have to give feedback to FCS for necessary input to drive.

2. **Rotatable Launchers:** The SR and LRMR (Port and Star boat) launchers are rotatable from the base, with training and elevation motors, to train and elevate the launcher, with its 16 tubes in each Launcher. The launcher is capable of being trained and elevated, based on the inputs received from the Fire Control System (FCS). The Training limits will be ' 0° ' to ±180° with 180° turn in 3 sec. The Elevation limits are 0° to +60°, with an elevation rate of 60° per sec. The precise training and elevation limits, as applicable to IN ships would be intimated, while

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placing the order for chaff systems. The launcher will have mechanical and electrical stops to prevent it from training outside the safety zones so promulgated.

3. Weight: The weight of the system shall be restricted to the minimum.

EMI-EMC: The entire system shall have total electro-magnetic compatibility with shipboard equipments. The equipment shall be capable of operating in the vicinity of other equipments without causing or responding to undesirable electromagnetic energy. The equipment design shall consider the electromagnetic interference (EMI) coming from the external sources, generated from within its own enclosure and degrading the practices like grounding, bonding and shielding. The EMI/EMC levels shall conform to MIL-STD 461C/D and be subjected to the following tests:-

Test	Description with Frequency Ranges
CE01	Conducted emissions, input power leads 30Hz to 15KHz
CE03	Conducted emissions, input power leads 15Hz to 50MHz
CS01	Conducted susceptibility, input power leads 30Hz to 50KHz
CS02	Conducted susceptibility, input power leads 50KHz to 400MHz
CS06	Conducted susceptibility, input power leads Spikes AC & DC power lead, Spike 400V, 5uSec +/- 20% duration.
RE01	Radiated emissions, magnetic field (30Hz to 50KHz)
RE02	Radiated emissions, electric field (14KHz to 10GHz)
RS01	Radiated susceptibility, magnetic field (30Hz to 50KHz)
RS02	Radiated susceptibility, magnetic & electric field, spike and power frequency test. (spike of 400V, 5uSec +/- 20% duration) 20 Amps of current are applied to the test wire at power frequency of the test sample.
RS03	Radiated susceptibility, Electric field (14KHz to 10GHz) Below deck units - 10 V/M Above deck units - 200 V/M

4. Operation Conditions: The system devices/equipments should operate satisfactorily in the marine environmental (Coastal Conditions) and other operating conditions given below:

- (a) Roll max  $\pm 15^\circ$  with 10sec period- Operational
- (b) Pitch max  $\pm 40^\circ$  with 10sec period- Survival
- (c) Heave max  $\pm 3^\circ$  with 7sec period- Operational
- (d) Yaw max  $\pm 5^\circ$  with 7sec period- Survival
- (e) Tilt (permanent) max  $\pm 3.5m$  with 7.5sec period- Operational
- (f) List max  $\pm 1m$  with 7.5sec period- Survival
- (g) Trim max  $0.8^\circ$  per  $s^2$  -Operational
- (h) Tilt (permanent) max  $2.2^\circ$  per  $s^2$  - Survival
- (i) List max  $15^\circ$  in any direction- Operational
- (j) Trim max  $30^\circ$  in any direction -Survival
- (k) List max  $20^\circ$  from vertical (permanent) -Survival
- (l) Trim max  $5^\circ$

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5. Environment Stress Screening (ESS) Test. ESS tests for electronic components/sub system is required to be carried out for 100% components/parts/assemblies. The severities of ESS test are placed at Annexure D.
6. Whether Capability: It should be possible to exploit the system up to Sea state 5 and wind-speed of 25 m/s.
7. Continuous Operation The system should be capable of 500 hours of continuous operation.
8. BITE: The system should have the capability for on line and offline maintenance diagnostics.
9. MTBF/MTTR The MTBF should be more than 2000 running hours. The MTTR shall not exceed 30 minutes for the electronics and one hour for the other components.

10. General Design and Manufacturing Requirements.

- 12.1 Power Supply. The system should be designed to work on 415V, 50Hz, 3Ph and 230V, phase to phase, 50Hz power supply of the ship. The system should enable to work on DC supply within the range of 22-27V. In case system needs any other power supply the same need to be catered for, wherever required, through the use of suitable converters etc., which are to be included in the scope of deliveries.
- 12.2 Modularity. The equipment should be designed for modularity in software so as to ensure quick and easy replacement of unserviceable modules and components. As regards software, the package should be modular to enable easy debugging and characterization for fitment of the FCS in different platform.
- 12.3 Components. All components should be of MIL grade approved type for use of warships. Standard specification and grade of material of each components used should be indicated in the binding drawings. Make and type of components are to be listed in the binding drawings. Use of non-MIL grade components is to be avoided; exception if any is to be brought to the notice of IHQ MOD (Navy) for approval.
- 12.4 Wiring. Wiring of the equipment should be with LFH wires.
- 12.5 Cable Entry Glands. Cable Entry Glands should conform to specification DGS/EED/VI/1535/R6 for incoming and outgoing cables. The size of the glands should be indicated in NES 512. Cable passed through magazines; oil or water tanks should be in accordance with NES 502.
- 12.6 General Requirements. The general requirements applicable for all sub-system like Power Supply unit, Launcher Interface units, JB's etc. are given at Annexure C.
- 12.7 Tally and Diagram Plates. All Tally and Diagram Plates should be anodized aluminum alloy or naval brass. Size of tally plate and their letters should conform to specification NES-723. VOLTAGE DANGER tally should be provided on the system at a permanent place where required. Safety marking on the units and associated devices /units should conform to NES784.
- 12.8 Lifting Arrangement. Units weighing more than 40Kg should be provided with collar eyebolts or suitable lifting lugs /arrangements. If the eyebolts

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cannot remain in situ after the unit has been installed on the ship, provision is to be made for securing arrangement on the unit.

- 12.9 Terminal. Bolted type terminal and crimped socket of electrolytic copper are to be provided for-all incoming and outgoing cables. Adequate spares terminal strip is to be provided for the provision of additional control and indication facilities. Adequate space is to be provided inside the units for bending and termination of incoming and outgoing cables.
- 12.10 Anti-Condensation Heating. Equipment shall be provided with Anti-Condensation Heating elements, which are to be switched on automatically when the equipment is switched off.
- 12.11 Surface protection and Painting Scheme: The system should be able to withstand marine environment, with surface protection schemes being provided, as per JSG 0457-01: 1986 Part-I, Part- II, Part- III and JSG 0457-01: 1997 Part IV. The paint used shall be fire retardant type and as per NHQ letter NC/0528 dated 04 Apr02.
- 12.12 Safety Standards: The system should offer total safety to personnel from moving parts and other associated equipment from shock. Safety standard as per MIL STD 4564 shall be met. All units are to be provided with earthing bolt. Where units are connected with the ship's main, fuse protection is to be provided. Each unit where dangerous voltages are present will bear a Red Label stating in bold white characters the highest voltages inside the unit. Doors and Panels are to be provided with safety door switches, wherever necessary
- 12.13 Overall dimension and weight of the equipment should be kept to the minimum as possible
- 12.14 Units of the system designated for shock mountings should be designed in accordance with BR 3011.
- 12.15 Standardization and Metrication. The equipment and all its components are to be fully in metric system. It is to be ensured that assemblies, subassemblies, components, part and material used should conform to the Joint Services Specifications.
- 12.16 Mounting Arrangement. The Mounting Arrangement for the FCS with respect to the ship needs to be indicated after consultation with the respective authorities.

11. Supplier scope of Equipment supply and Schedule

The supplier's scope of system supply should cover the supply of equipment, installation Material, Drawings and Documentation, installation supervision, setting to work, testing & tuning on board commissioning, harbour and sea acceptance trial of shaft system "Kavach MOD-II". The supplier is to list down in details the deliverables to be provided to the customer at various stages of supply of the system by supplier per ship should include as given in succeeding paragraphs.

13.1 First Run Items

- > Interface Units-as required.
- > Inter unit-connection cables-1set.
- > Accessories required completing the installation of the system.

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- 13.2 Item Standardization. The necessary IIG (Item Identification Guide) forms need to be completed and forwarded to the AHSP. To enable allocation of DS CAT number by the Directorate of Standardization, the manufacturer had to furnish the codification forms to the concerned AHSP to assist Standardization.
- 13.3 Installation Material: One set of installation material that includes connectors, shock mounts, special fasteners, special fittings etc. should be supplied by the supplier.

**14. Design Documentation/ Binding data and Technical documentation.**

Design Documents/ Binding Data/ Drawings All associated design documentations, drawings and equipment list applicable must be in English language. All drawings and documents should contain dimensions and other parameters in metric units (SI Units). The drawing and documentation should be complete to enable installation on board. These shall cover all sub-assemblies and accessories of the equipment. The documents/drawings shall be provided in both hard copy form and on CD-ROM within 6 weeks after placement of the order. An Interactive Electronic Technical Manual also needs to be provided with the system. The design documents/drawings should conform to NES 722 and supplied.

**14.1 Binding DATA/Drawing/Documents.**

Three hard copies & 2 sets on CD ROM of the following binding drawing /documents are to be supplied by the OEM within 3 weeks of placement of order:

- (a) System Cable Diagram with list of cables and connectors showing interface with others ship's system.
- (b) Overall dimensional drawing of all the equipments (indicating dimension of transportable section) with seating details, space required for maintenance and indicating requirement of shock mounts;
- (c) Installation Procedure for installation with sequence of activities;
- (d) Weight & CG of the equipments;
- (e) Limitations on inter-unit separations and cable length restriction.
- (f) Heat dissipation, power requirement with load from ship's supply for the equipments, requirement of ship's services viz. chilled water/sea water, LP/HP air and buttoning up arrangement showing inlet/outlet, consumption rate, temperature, quality of air etc.
- (g) Alignment requirement for installation.
- (h) Thrust parameters of launcher with flight path of the rockets, pressure and temperature curve, flash duration etc.
- (i) Polar diagram of launcher operation.
- (j) Any other special instructions for installation and preservation.

**14.2 Technical Documentation/ manuals**

- a) Firm is required to submit one hard copy and one soft copy of the draft system documents including software documents of IHQ (MOD-N) for vetting at least 3 months prior to conduct of FATs of the system.
- b) One set of finalized / approved documents should be supplied and one soft copy on CD ROM of documents should be supplied free of cost with the order.

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- c) Supply of documents will be part of the order and cost included in the order.
- d) Documents in CD-ROM are to be as an interactive Electronic Technical manual (IETM).
- e) The format and content of documentation should be as per specifications JSS-0251-01-2002 (Rev) and EED-S-048. The vetting and approval of the documents would be done by AHSP..
- f) Software documents should be as per IEEE 12207 standard.
- g) The documentation and drawings should contain complete information for installation operation, maintenance, repair and overhaul, testing and trials and shall include the following:

Sl.No.	Description	Remarks
(a)	Design Specifications	
(b)	User hand book	Covers composition and brief description of:  (a) Equipment with block diagram (b) Technical parameters (c) Brief technical description with photographic or graphical representation of each units (d) Detailed functional and operating instructions giving safety instruction, precautions, switching-on and switching off procedures, (e) Tables of fault indication and fault codes etc (f) Storage preservation / de - preservation, transit procedure etc.
(c)	Technical Manual	Covers detailed technical description of each unit with associated drawings and diagrams. It will also include data on integrated circuits and semiconductor components.
(d)	Installation manual	Covers composition of equipment, cabling diagram and cable specifications, cable connection schedule, complete binding data, installation drawings, list of installation materials, list of accessories, detailed installation instructions.
(e)	Maintenance and Repair manual	Covers instructions on servicing; planned preventive maintenance; on dismantling and assembling of each unit; faults, their causes and remedial action, repair, overhaul and reconditioning, testing, adjusting, calibrating and tuning of each unit, list of special tools, test equipment, jigs and gauges.
(f)	Maintenance Schedule	Comprehensive Maintenance Schedules will be provided along with system.

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		These schedules will cover all the relevant aspects and provide the user/maintainer with adequate literature for reference, to prepare the Engineering Support Documents.
(g)	Part catalogue, List of spare parts, Test Equipment	The manual should include Catalogue of parts listing out all the replaceable parts  (a) List of test equipment (b) Service Log Books
(c)	Test and Trial Schedules  (a) In-production Test Procedures (b) Engineering, Environmental and Quality Inspection Procedures (c) Factory Acceptance Trials Schedule (d) Preliminary System Acceptance Trials Schedule (e) Installation Check Schedule (f) Harbour Acceptance Trials Schedule (g) Integrated Harbour Acceptance Trials Schedule (h) Sea Acceptance Trials Schedule	
(d)	Instructions on Testing & Tuning and Setting to Work	Contains instructions on Testing and Tuning, alignment, checking and adjustment to individual parts and of the equipment as whole.
(e)	Software Manual	Software logic for the Fire Control System
(f)	System Integration Plan	Contains technical details and all the hardware and software interfaces with the external systems.
(g)	'As Made' drawings	As applicable
(h)	Test data / certificates	As applicable
(i)	Firm-ware Support Manual	This will contain the procedure to reprogram all the programmable devices.

**15. Quality Assurance**

The design, material and workmanship should be in accordance with the best worldwide-recognized marine practices, to ensure reliability, durability and ease of maintenance, which will comply with the ship's requirements. Reliability and quality assurance methods should be applied during design, manufacture and testing. The SUPPLIER should provide the necessary quality control details for testing/ analyzing the system, for the design parameters specified. The SUPPLIER should also provide the draft of the user acceptance criterion for performance of the system. A quality assurance plan is to be specified by the SUPPLIER in his offer. The MQAP, with details of the quality assurance/ control programme proposed to be adopted for the Kavach Mod-11 system, should be laid down, along with the guidelines to be followed and shall be finalised by QA Committee comprising representatives from DAQN, DGNAI, IHQ MoD(N) and SUPPLIER. The inspection will be undertaken

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by the inspection agency nominated by the IHQ-MOD (N) at the factory premises as per the approved QAP.

15.1 Details of test equipment, test methods, preliminary qualification tests, etc. are to be indicated. Shop floor tests prior to dispatch by supplier shall be conducted.

15.2 Pre and Post Electrical performance checks during Environmental test of panels need to be witnessed by QA Agency. Accordingly, the system supplier shall plan his schedule of offering of the components/subsystems and final assembly and the same may be intimated to the QA Agency.

16. Inspection, Testing, Installation, STW :

16.1 Inspection and testing

- (a) Inspection Authority: Inspection Authority nominated by MPF.
- (b) Receipt Inspection: Warship Overseeing Team (WOT) of IHQ-MOD (N).
- (c) For Installation: Warship Overseeing Team (WOT) of IHQ- MOD (N).
- (d) For ship trials: WATT (V)

(i) The product offered by the manufacturers should conform to standard engineering practices. The system will be subjected to stage inspection and final test and trials by MPF as mutually agreed with the manufacturer. Any deviation from the mentioned specifications will be brought to the notice of MPF.

(ii) The system should be designed and guaranteed to withstand the shock standards as per JSS 55555 while ensuring system integrity is not affected. There must be no significant effect on performance essential components that may affect overall ship safety or combat capability and in no way must they be hazardous or dangerous to personnel through failure of system components arising from shock, The manufacturer shall repair the equipment in the event the equipment is damaged as a result of the shock test not exceeding the calculated shock impact loads.

16.2 Factory acceptance trials (FATs). The supplier to offer the system for FATs, (including ATFs) as per NHQ approved schedule.

16.2.1 Factory acceptance trials (FATs). FATs of the system shall be carried out at the factory of the SUPPLIER, based on the Acceptance Test Plans and Procedures provided by the SUPPLIER. MPF nominated team shall witness the performance of such FATs. The schedule shall state how the supplier would demonstrate that the delivered system would meet the functional and performance requirements indicated. The factory acceptance trails procedure shall comprise of:

- (a) Functional Tests.
- (b) Verification of design, especially firmware and software.
- (c) Pass/Fail criteria.
- (d) Expected duration and time phasing.

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16.2.2 The FATs Schedule after being formulated by the supplier shall be forwarded to MPF for vetting and approval.

16.2.3 All EMI/EMC test para 2.10 need to be completed prior to FATs.

16.2.4 Simulators for FATs: During FATs, the system performance would be checked with simulators for Roll, pitch, CMS-28, Log, Gyro, Wind indicators etc.

16.2.5. The system will be integrated with launcher, electrical sub systems and fire control systems at MPF. After integration, the system will be offered to Indian Navy as a part of FATs of the system. The firm has to connectorise, interface and check the functionality as per approved check list during the FATs at MPF.

16.3 Installation. On board installation of the system will be carried out by the Shipbuilder. The assistance and responsibilities of the OEM shall include the followings:

- (a) Coordination with the Shipbuilder for the installation work.
- (b) Providing instructions to the Shipbuilder personnel for installation and mounting of launchers and other units of the system.
- (c) Providing instructions to the Shipbuilder personnel for installation and mounting of the cable connectors of the system. The shipbuilder before start of the installation activities will do Cable laying.
- (d) Checking of the cable connection (cold wire test).

16.4 Setting-to-Work. The supplier should carry out:

- (a) Setting-to-work.
- (b) Testing and Tuning of the system.
- (c) Alignment Test of launchers.

16.5 Harbour Acceptance Trails (HATs) and Sea Acceptance Trails (SATs). The supplier is required to provide necessary representative(s) to assist during the following phases:

- (a) HATs (Procedure to be approved by Naval Headquarters)
- (b) SATs (Procedure to be approved by Naval Headquarters)

16.6 System Performance Responsibility. In case of any irregularities in the operation performance of the system or non conformance to specified parameters observed on integration with ships system, the supplier is bound to rectify the defect. The supplier shall ensure complete responsibility of satisfactory operation of the system on board.

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**16.7 Interface and Integration.** The supplier is responsible for the interfacing and integration of KAVACH MoD II with ships onboard systems in accordance with the interconnectivity matrix promulgated. Interface protocols for interfacing of these systems will be mutually finalized between the manufacturer and MPF. Services of Supplier's engineers/ technicians/ workmen for installation, Integration with other ship's systems, STW, HATs, and SATs of the system shall form part of the order.

**17. Other terms and conditions**

**17.1 Interface Definition**

External system interfaces should be as per MPF approved ICM (Inter Connectivity Matrix). SUPPLIER shall finalize interface Protocol in consultation with MPF and Suppliers of other ship's systems for satisfactory operation of system interfaces. The equipment shall be designed and constructed so that it can be fully integrated with the systems to which it interfaces.

**17.2 Transportation**

All equipments shall be adequately packed and protected with supports to ensure adequate protection during all modes of transportation. Each unit within a package/container shall be clearly marked for identification. The container shall clearly indicate the item description with caution marks, quantity, weight, size, etc. A separate document giving complete details and instructions for storage, preservation, handling and transportation after delivery is to be supplied. The SUPPLIER shall indicate the delivery schedule, transport, packing, preservation, insurance, etc.

**17.3 Preservation**

The SUPPLIER shall depute the required representative(s) with oil, lubricants, hydraulic liquid and other necessary preservative materials to SHIPYARD for carrying out scheduled maintenance and preservation of the system till commissioning.

**17.4 Reliability & Maintainability.** The requirements of reliability and maintainability as described in the Document DOS (W)-S-03/95, must be complied.

**17.5 Maintenance.** The manufacturer shall provide recommended maintenance schedules for preventive and corrective maintenance of the system.

**17.6 Product Support.** The supplier shall undertake to ensure guaranteed and continuous product support for a period of 20 years from the date of supply of the first system and associated equipment, by way of the following:

- (a) Supply of spare parts and materials
- (b) Offering of alternative solutions in the event of obsolescence of the Components/technologies, including those bought out or subcontracted.
- (c) Continuous up-gradation programme.
- (d) Continuous supply of amendments to the documentation.

**17.7 Hardware Warranty.** The warranty period of Kavach Mod-II system shall be for 48 months from the date of receipt of the system at MPF. The system

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supplied shall be warranted from defects, manufacture and performance for the said period and cover all the defects arising from malfunction through design faults, inappropriate material, bad - production and non-conformance to specifications. Any expense on account of repair/supply of spares against guarantee defects is to be borne by the supplier.

17.8 Upgrades and Obsolescence. All upgrades and modifications in the hardware and software of the system need to be communicated to MPF for the complete support life of 20 years. Obsolescence of sub- system, components, parts and assemblies need to be communicated to MPF at least two years in advance with recommended remedial action.

17.9 Authority Holding Sealed Particulars (AHSP). MPF would be the AHSP for all the sealed particulars of Kavach Mod-II and associated sub systems/ equipment.

17.10 Basic Training: The OEM shall undertake the training of naval personnel and MPF on the maintenance and exploitation of Kavach Mod-II.

17.11 Scope of offer

The following information is to be supplied with the technical offer:

(a) The technical offer should include the following technical and design details:

- (i) System Overview
  - (ii) Design Philosophy
  - (iii) Design Objectives (Survivability, Reliability, Redundancy, Modularity, Standardization, Graceful Degradation, flexibility, etc)
  - (iv) System Configuration
  - (v) System Description with Block Diagram
  - (vi) Material specification of components and system
  - (vii) Description of sub-systems with Block Diagrams
  - (viii) System Operation
  - (ix) System Software (Software Components, Brief Description of S/W & Architecture)
  - (x) System Startup, BITE and system Diagnostic
  - (xi) HMI Functionality
  - (xii) Technical Specifications of Systems/Sub-Systems
  - (xiii) Environmental Specifications of Systems/Sub-Systems
  - (xiv) Description of Interfaces with Other Onboard Systems with Block Diagrams
- (b) Scope of work
- (c) Following initial binding data: -
- (i) Cable diagram of the system.
  - (ii) Weight and, outline drawings of the equipment indicating overall dimensions, CG and maintenance envelope, installation instructions, buttoning-up arrangement, if any
  - (iii) Power supply requirements with load for the equipments.
  - (iv) Heat dissipation of the equipments.

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- (v) List of cables and connectors.
- (vi) Details of interface requirement with other on board systems.
- (vii) Tools required for installation, T & T and maintenance.
- (viii) Special tool and test equipment to be supplied for on board maintenance.
- (ix) Supplier's list of spares for installation and commissioning.
- (x) Trial and commissioning time for complete system on board.
- (xi) Part identification list at sub units' level.
- (xii) List of main equipments included in the standard scope of supply.
- (xiii) List of accessories included/ not included in the standard scope of supply.
- (xiv) List of optional units and accessories not included in the standard scope of supply.
- (xv) List of all installation materials and accessories.
- (xvi) List of equipments required for installation and operation of the equipment and not supplied by the Supplier.
- (xvii) List of materials, tools, and fixtures required for shore preservation of the system.
- (xviii) List of wiring jigs for the subunits and lifting jig for the launchers.

17.12 L.D. Clause: Extension of contracted delivery period will be at the sole discretion

of the Buyer, which will be either with or without applicability of L.D. Clause, Liquidated Damages @ 0.5% per week or part thereof subject to a maximum of 5% of the cost of undelivered stores will be recovered in case of delay in delivery beyond the accepted delivery period.

17.13 The supplier shall make necessary arrangement for sustaining the system operation

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Annexure 'A1'

Specification: AC Servo Amplifier with built in power supply

1.	AC Servo Amplifier with built in power supply	
2.	Power Section:	
(i)	Input supply for power section	230 TO 480V AC , 3 phase, 50 Hz.
(ii)	Output voltage V DC	565V, Unregulated
(iii)	Output current (continuous) A DC	32A ( 565V x 32A = 18080W)
(iv)	Peak current (150ms) A DC	64A ( 565V x 64A = 36160W)
(v)	Rated power KW	18.08
(vi)	Cooling method	NATURAL/FORCED AIR
(vii)	Bleeder continuous power W	300
3.	Control Section:	
(i)	Input supply for control	24C DC -6A SUPPLY EXTERNAL, 1 phase, 50 Hz
(ii)	Output voltage for customer V DC	24V
(iii)	Output current for customers use A DC	MAX 2 AMPS
4.	General:	
(i)	Storage temperature degree C	25 TO 55
(ii)	Operating temperature degree C	10 TO 45
(iii)	Max. Operating altitude above sea level	1000m
(iv)	Max. Relative humidity %	95 or less non-condensing
(v)	Protection class	IP20 EXCEPT TERMINALS
(vi)	Approximate weight Kg.	7.5 KG
(vii)	Approximate dimensions (d b h) mm (Including Mounting flange at Top & Bottom)	110 X 190 X 200, EXCLUDING TERMINATION
5.	Protections:	
	Internal over temperature of heatsink, high voltage on dc bus, bleeder resistor over Temperature, Bleeder resistor ON time.	DC HIGH VOLTAGE,HIGH CURRENT,OVER VOLTAGE TO SAFE GUARD AMPLIFIER
6.	LED Indications:	
(i)	Power supply ready – Green (LD3), Drive ready – Green (LD4)	THROUGH SEVEN SEGMENT DISPLAY
(ii)	Bleeder Fault/ Heat sink over temperature – Red (LD2)	THROUGH FRONT PANEL 7SEGMENT DISPLAY
(iii)	DC Bus ON – Green (LD1)	THROUGH FRONT PANEL 7SEGMENT DISPLAY
7.	Discrete Outputs:	
(i)	1 No. Potential free contact indicating power supply ready	AVAILABLE FOR EXTERNAL USE
(ii)	1 No. Potential free contact indicating system ready (power supply and drives)	AVAILABLE FOR EXTERNAL USE

Specification: AC Servo Drive

	AC Servo Drive Specification:	
1.	Power Section:	
(i)	Input voltage (V DC) Unregulated	565V unregulated
(ii)	Device Rating	RATED 32 AMPS AND PEAK CURRENT RATING S 64 AMPS
(iii)	Cooling method	FORCED COOLING
(iv)	Operating frequency (kHz)	DEFAULT 8KHZ
2.	Control Section:	
(i)	Control voltages (V) from a DC Bus operating SMPS	The +15 V / -15V are derived
(ii)	Max. Internal current consumption of +15 V (A DC)	
3.	General:	
(i)	Input supply for fan and SMPS 1 phase, 50 Hz	NOT REQUIRED
(ii)	Storage temperature (Degree C)	25 TO 55
(iii)	Operating temperature (Degree C)	10 TO 45

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(iv)	Max. Operating altitude above sea level	1000m
(v)	Max. Relative humidity (% RH)	95 or less non-condensing
(vi)	Protection Class	
(vii)	Approximate weight (Kg)	20
(viii)	Approximate dimensions ( D B H ) mm (Including Mounting flange at Top & Bottom)	300 x 155 x 400
(ix)	Analog input	0 to + 10V DC speed
(x)	Command Reference or Torque (max. 1 mA	
(xi)	Inputs enable.	+15 V DC for controller.
(xii)	Output to power supply Indicating drive Ready.	Open collector signal
(xiii)	Feed back from motor	Resolver
	Position and Analog tacho (3V / 1000 rpm) for Speed.	
(xiv)	Analog outputs	0 to +10 V for speed
	indication and Current.	Front Panel 7 Segment Display
4	Standard Features:	
(i)	Differential speed reference input	0 TO
(ii)	Controller and motor optimisation through programming module.	SOFTWARE OPTIMISATION AND AUTO TUNING FACILITY .ONLY REQUIRED PARAMETERS CAN BE OPTIMISED PC/ETHERNET
(iii)	IGBT based PWM control.	IGBT BASED PWM CONTROLLER
(iv)	Gate drive derived from DC bus operated SMPS.	
5	Protections:	
(i)	Power supply (+15V, 24V, SMPS drive supply, DC Bus) for under voltage and over Voltage; Tacho loss, Over speeding; Internal over temperature; output short circuit, Earth fault; loss of Rotor Position feedback.	FRONT PANEL DISPLAY BUILT INFUNCTIONAL SAFETY ASPER EN61508 ,EN62061, ENISO 13849-1,IEC 618000-5-2
6	LED Indications: @	
(i)	Drive ready – Green (LD1).	FRONT PANEL ERROR DISPLAY
(ii)	Tacho loss, over speeding – Red (LD5).	FRONT PANEL ERROR DISPLAY
(iii)	Power supply healthy – Green (LD2).	FRONT PANEL DISPLAY
(iv)	Over Temperature – Red (LD4).	FRONT PANEL ERROR DISPLAY
(v)	Output short, Earth fault, Transistor short, Peak Trip)– Red (LD6).	FRONT PANEL ERROR DISPLAY
(vi)	Controller enable – Yellow (Green) (LD3).	FRONT PANEL ERROR DISPLAY
(vii)	Rotor position indication – Yellow – 3 (Green –3	FRONT PANEL ERROR DISPLAY
(viii)	TACHO TRIP AND PEAK TRIP ARE INDICATED THROUGH LED ON ODC CARD	

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Annexure 'B'

AC Servo Motor with Brake

Technical Data:		
1	General:	
(i)	Voltage Gradient No load	88 Line-Line V(Peak)/ 1000 RPM
(ii)	Maximum Current (Peak)	210 Amps
(iii)	Maximum Terminal Voltage	350 Line-Line Volts
(iv)	Max. Speed	2900 RPM
(v)	Continuous Stall Torque TENV	38.8 Nm
(v)	Peak Stall Torque	120
(vi)	Continuous Stall Current DC	24.42
(vii)	Rotor Polar Moment of Inertia (Inclusive of Tachogenerator Inertia)	79.36 0.0087 Kg - m <sup>2</sup>
(viii)	Torque Constant KT Line-Line	1.59 Nm/Amp
2	Stator Winding:	
(i)	Resistance Line-Line	0.265 Ohms
(ii)	Inductance Line-Line	3.379 Millihenrys
3	Thermal:	
(i)	Insulation Class	F
(ii)	Max. Ambient Temperature	25 °C
(iii)	Thermal Time Constant	3775SEC [62.91MIN]
(iv)	Thermal Resistance	0.304 °C/Watt
4	Mechanical:	
(i)	Mechanical Time Constant	3.775 Milliseconds
(ii)	Static Friction Torque	0.14NM
(iii)	Cogging Torque	0.76 Nm
(iv)	Motor Weight	27.2 Kg
5	DIMENSION	
(i)	LENGTH	360 MM
(ii)	FLANGE	190 MM
(iii)	FLANGE THICKNESS	11 MM
(iv)	MOUNTING SPIGOT	180 MM
(v)	SPIGOT THICKNESS	3 MM
(vi)	SHAFT LENGTH FROM FLANGE END	60 MM
(vii)	SHAFT DIA	32 MM
(viii)	KEY	40 MM   OPTIONAL
	KEY SIZE 45 X10.9 X 8.11	40X 10 X 8 MM
(ix)	CONNECTORS	CD SERIES RIGHT ANGLE CONNECTOR

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ENVIRONMENTAL STRESS SCREENING

Sl.No.	Test	Conditions	Authority
(a)	Thermal Cycling	(A) 0° C to 50° C, 60 Min (For commercial grade components) (B) -40° C to + 70° C, 60 Min (For MIL Grade components) (C) Change over time 03 min. (D) Number of cycles - 06	100% on all PCB
(b)	Vibration Test	Random vibration freq 20-2000 Hz Power density 0.2g <sup>2</sup> / Hz - 10min Each in at two axis (including most severe axis)	Fully wired card cages, power amplifiers, power supplies, modules, sub-assemblies etc.
(c)	Burn-in	168 hrs at room temperature under maximum load	Complete system set

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at PCB Modules (LRU) level. Ships staff as part of first line maintenance would undertake routine maintenance and serviceability check/ terminal performance checks.

2. Second level repair/maintenance. Second level repair/ maintenance of the system would normally be undertaken by shore-based unit (Dockyard) and will be restored to when: -

(a) Second level maintenance involving higher skills and/or elaborate set ups are required.

(b) Periodic parameter checks and record of performance is to be undertaken as part of STW/HATs or after major components/ sub units of the system have been replaced.

3. Third/Fourth Level Repair/ Maintenance. Third/ fourth level repair/ maintenance would include following: -

(a) PCB/ module repairs down to component level.

(b) Repairs/overhaul/refurbishing and testing of major assemblies/ complete system.

(c) Setting to work, testing and tuning on board ships after major repairs/ overhauls.

(d) Repair and calibration of BITE and other test equipment.

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(Neeraj Agrawal)  
Jt. General Manager  
For Sr. General Manager

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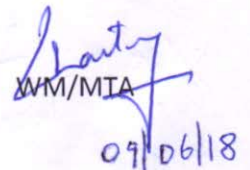
Annexure "X" ✓ 18/18C3)  
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## SCOPE OF WORK FOR MANUFACTURE AND SUPPLY OF ELECTRICAL SUBSYSTEM OF KAVACH MOD II

1. Firm should submit the ATP, BOM and Drawings to MPF/Navy for approval of the same. The additional compliances mentioned by Navy will have to be addressed by the firm in total.
2. Wastages (like prototype, models, test jigs, tools and equipment's and other intellectual property documents including test reports) generated will be proprietary property of MPF and the firm will have to supply the same to MPF free of cost without any financial liability. The list of wastages after compliance of point no 1, to be submitted to MPF and to be included in the list of deliverables.
3. Inspection of the system is to be carried by Naval Inspectors.
4. Firm to support in the commissioning of the system during FATs, HATs and SATs.
5. Firm to send Qualified Manpower to MPF/Ship for commissioning manpower as per availability of ship and on short notice i.e 24 hours.
6. Any repair during Guarantee/Warranty period should be carried out by the firm with qualified manpower free of cost and on short notice as per availability of ship.
7. Non-Disclosure Agreement and Non Competitive agreement in Kavach or equivalent is to be signed by the firm with MPF, as the item would be Proprietary of MPF.
8. For the entire Kavach Project MPF is the OEM and the full or part is Proprietary of MPF.
9. Firm should confirm availability of spares of their designed system during operational life of Kavach as approved by Navy Point 1 and if required must have capacity for Obsolescence Management.
10. Delivery Period: 4 months from the date of placement of supply order
11. Guarantee/Warranty: 48 months from the date of receipt of store at MPF or 24 months from the date of commissioning of the system onboard the ship whichever is earlier.



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**VENDOR QUALIFICATION CRITERIA FOR MANUFACTURE AND SUPPLY OF  
ELECTRICAL SUBSYSTEM OF KAVACH MOD II**

1. Firm should have supplied any Controlled Servo based Electrical System for Weapons to the Navy with an order valuing more than 70 lakhs.
2. Firm should have expertise/experience in qualifying the system for EMI/EMC and JSS 55555 tests.
3. Firm should have expertise/experience in handling Digital Servo Drives and Servo Motors.
4. Firm's to submit documentary evidence for Compliance to the above points (1) to (3). Firms not complying to the above requirements may be disqualified.

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**LIST OF PLANT AND MACHINERY FOR MANUFACTURE AND SUPPLY OF  
ELECTRICAL SUBSYSTEM OF KAVACH MOD II**

1. Multimeter
2. Megger
3. Tachometer
4. Soldering Station
5. Laptop
6. Ethernet Hub/Switch

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