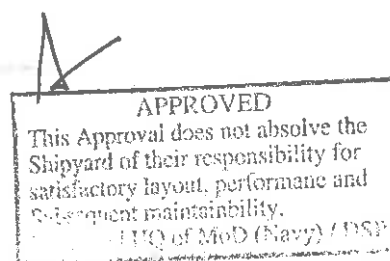




Project	MPV
Document No.	18000-00000-4-791-001
Shipyard	Larsen & Toubro
IHQ MoD(N)/Directorate	IHQ MoD(N)/DSP

STATEMENT OF TECHNICAL REQUIREMENT FOR INTEGRATED PLATFORM MANAGEMENT SYSTEM

(This SOTR contains 49 pages including cover page)



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Record of Revision

Rev No.	Amendment	Date
00	First Release	29-09-2022
01	Updated to incorporate <i>IN</i> comments	22-06-2023
02	Updated to incorporate <i>IN</i> comments	24-07-2023
03	Updated to incorporate <i>IN</i> comments	05-08-2023

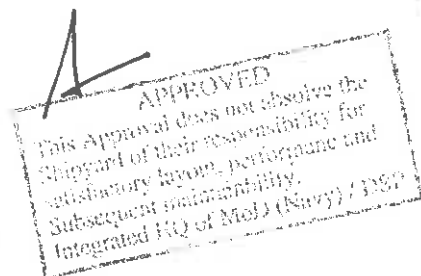
Revision Note

This document 's version is 18000-00000-4-791-001/R03

Date of Issue : - 08/23

Historical Record

1. This document supercedes 18000-00000-4-791-001/R02 dated 24-07-2023



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ABBREVIATIONS

<u>Ser</u>	<u>Abbreviation</u>	<u>Full Form</u>
1.	ABN	AIR BORNE NOISE
2.	APMS	AUTOMATIC POWER MANAGEMENT SYSTEM
3.	ATP	ACCEPTANCE TEST PLAN
4.	B&D	BASE AND DEPO
5.	BDCS	BATTLE DAMAGE CONTROL SYSTEM
6.	BIT	BUILT IN TEST
7.	CAN BUS	CONTROLLED AREA NETWORK BUS
8.	CCD	CONFIGURATION CONTROL DOCUMENT
9.	CDR	CRITICAL DESIGN REVIEW
10.	CG	CENTRE OF GRAVITY
11.	COTS	COMMERCIAL OFF THE SHELF
12.	DEFSTAN	DEFENCE STANDARD
13.	EMC	ELECTRO MAGNETIC COMPATIBILITY
14.	EMI	ELECTRO MAGNETIC INTERFERENCE
15.	FATs	FACTORY ACCEPTANCE TRIALS
16.	HATs	HARBOUR ACCEPTANCE TRIALS
17.	HMI	HUMAN MACHINE INTERFACE
18.	IEC	INTERNATIONAL ELECTROTECHNICAL COMMISSION
19.	IETM	INTERACTIVE ELECTRONIC TECHNICAL MANUAL
20.	INCAT	INDIAN NAVAL CATALOGUE
21.	IPMS	INTEGRATED PLATFORM MANAGEMENT SYSTEM
22.	LFH	LIMITED FIRE HAZARD
23.	MIL-STD	MILITARY STANDARD
24.	MRLS	MANUFACTURER RECOMMENDED LIST OF SPARES
25.	MSB	MAIN SWITCH BOARD
26.	MTBF	MEAN TIME BETWEEN FAILURES
27.	MTBO	MEAN TIME BETWEEN OVERHAULS
28.	MTTR	MEAN TIME TO REPAIR
29.	NECP	NAVAL EMC CENTRE PUBLICATION
30.	NES	NAVAL ENGINEERING STANDARD
31.	OBS	ONBOARD SPARES
32.	OEM	ORIGINAL EQUIPMENT MANUFACTURER
33.	PDR	PRELIMINARY DESIGN REVIEW
34.	PIL	PART IDENTIFICATION LIST
35.	QAD	QUALITY ASSURANCE DOCUMENT
36.	QAP	QUALITY ASSURANCE PROCEDURE
37.	R&S	RANGING AND SCALING
38.	SATs	SEA ACCEPTANCE TRIALS
39.	SBN	STRUCTURE BORNE NOISE
40.	SDN	SHIP DATA NETWORK
41.	SOTR	STATEMENT OF TECHNICAL REQUIREMENT
42.	STW	SETTING TO WORK
43.	SV MOUNTS	SHOCK AND VIBRATION MOUNTS
44.	TNC	TECHNICAL NEGOTIATION COMMITTEE

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CHAPTER 1 – GENERAL

1.1 Introduction

- 1.1.1 This Statement of Technical Requirement establishes the specifications for design, supply, interface, testing and commissioning of Integrated Platform Management System for two (02) in numbers of Multi-Purpose vessel for Indian Navy.
- 1.1.2 Primary role of the ship includes Towing of *IN* ships, Launch/ Recovery of torpedoes, Trial Platform for naval weapons and sensors under development, Maritime Surveillance, Maritime Patrol, Maritime presence and Intelligence.
- 1.1.3 In addition Secondary role includes HADR, Support platform for ISV ops & Salvage Operations, Surveillance and offshore patrol (Close to Coast), Limited Hospital ship capability and Logistic support for Island Territories.

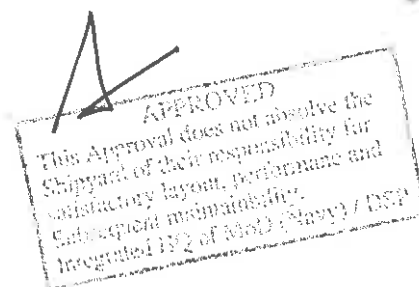
1.2 Principal Particulars of the Vessel

- 1.2.1 The equipment are to be provided for Multi-purpose Patrol Vessel having following main particulars:

Length overall	:	approx. 110 m \pm 5%
Beam	:	Commensurate to the ship's design
Draught	:	\leq 4.5 m in full load condition
Displacement	:	\geq 3500 T
Endurance	:	> 7200 nautical miles at economical speed, with 25% reserve fuel
Max. Speed	:	15 knots
Complement	:	08 officers and 108 sailors

- 1.2.2 Speed criteria & operating profile of the Ship:

- (a) Maximum speed : Not less than 15 knots (at 85% MCR), in deep displacement condition.
- (b) Economical speed : \geq 10 knots.
- (c) Operating Profile of Ship-
- | | |
|----------------|----------------|
| 0-8 knots | : 10% of time |
| 8-12 knots | : 60 % of time |
| 12-15 knots | : 25% of time |
| Above 15 knots | : 5% of time |



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1.3 Design, Environmental and Seaway Conditions

1.3.1 The equipment and the accessories including all associated sub system should be capable of continuous operation under the following conditions:

Ambient air temperature	: -10°C to 45°C
Machinery Room temperature	: 10°C to 55°C
Sea water temperature	: Upto 40°C
Relative Air humidity	: 90% at 32°C
Ambient Sea water temperature	: Max 35°C
Relative Air humidity	: 95%
Salinity of sea water	: 35000 ppm
Seaworthiness	: Up to Sea State 5

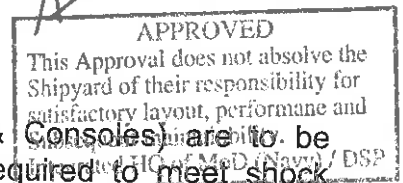
1.3.2 Area of Operation: The Ship is expected to operate worldwide.

1.3.3 List/Roll/Pitch:

(a) All Equipment shall be capable of efficient operations as per the seaway conditions of the vessel as below:-

Roll : Max 20 deg with 10 Sec period.
Pitch : Max 6 deg with 20 sec period.
List : Max 20 deg from vertical
Trim : Max 5 deg.

1.3.4 Shock Standards: All main equipment (RTU & Consoles) are to be mounted on suitable shock mounts and are required to meet shock standard NSS II i.a.w IN Shock Policy letters EG/5522/Policy dated 11 May 2007 and EG/Policy/TSV/13/2016 dated 13 Dec 2016.



1.4 Guarantee & Warranty

1.4.1 Warranty: The warranty shall be for a period of 36 months from the date of delivery of equipment/ items to the yard or 12 months from the date of delivery of the respective vessel to the Customer, whichever is earlier. The dispatch schedule will be finalized jointly by shipyard/OEM at the time of placement of PO. The associated equipment supplied and each component used in the manufacture thereof shall be free from all types of defects / failures.

1.4.2 If during the period of warranty, the defect is reported wherein the equipment failed to perform as per specifications, the OEM shall either replace or rectify the defect free of charge within 14 days of notification. Warranty of the equipment would be extended by such duration for the downtime.

1.4.3 Spares required for warranty repairs shall be provided free of cost by OEM. The OEM also will diagnose, test, adjust, calibrate and repair /

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replace the goods/equipment arising due to accidents, by neglect or misuse by the operator or damage due to transportation of the goods by the Yard/Customer during the warranty period, at the cost mutually agreed to between the Yard/Customer and the OEM, subject to acceptance of the attributability by the Yard/Customer of such damage, which will be intimated by the OEM to the Yard/Customer.

- 1.4.4 The OEM will provide necessary service and repair back up during the warranty period of the equipment and he will make endeavor that the downtime is within 14 days at any one time from the notification of such defects. However, subject to the prevailing conditions, location of the vessel or time for sourcing the spares, additional time may be required for rectification and this shall be intimated by OEM prior to initiating the repairs.

1.5 Technical Documentation

- 1.5.1 Documentation for all equipment and systems are to be supplied by OEM in accordance with latest version of DME 452 and EED-S-048 (as applicable) and IETM Level 4 format comprising following:-

- (a) Operation Manual - 10 hard copies
- (b) Technical Description Manual -10 hard copies
- (c) Maintenance & repair Manual - 10 hard copies
- (d) Installation Manual – 10 hard copies
- (e) Comprehensive Part Identification List (CPL / PIL) with list of all changeable / replaceable parts - 10 hard copies
- (f) As made equipment drawings – 10 hard copies
- (g) Two (02) nos. of Soft copies of all the above document are to be provided in separate CD (ie: 02 nos. of CD) for each vessel.

- 1.5.2 All trial documents should be submitted for clearance by appropriate authority six months prior commencement of equipment/system trials. The final revised documents should be available at the time of trials.

- 1.5.3 The Parts Identification List (PIL) / Comprehensive Part Identification List (CPL) in ILMS format to be provided to the buyer for all equipment along with MRLS one month prior to formulation of B&D.

- 1.5.4 As made equipment drawings, maintenance, repairs and refit documents, catalogue of spares for OBS and B&D inventory for the system are to be provided along with the vessel.

- 1.5.5 As made drawings, schematic and layouts of systems along with system description and operating procedure, system balancing, OBS, recommended routines and maintenance schedule are to be enclosed within these manuals (and not provided loose) in a manner that they can be easily removed and replaced.

- 1.5.6 Following indicative documents to be submitted along with the Offer:

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Sl. No	Requirement
1.	Dimension &, footprint drawing, Maintenance Envelopes for equipment including weight and Center of Gravity of the equipment
2.	BOM
3.	Heat Dissipation details of Equipment and its auxiliaries
4.	Schematic drawing (scope of supply details are also to be indicated)
5.	Proposed System Architecture comprising of complete IPMS including BDCS, Integrated Propulsion machinery control system and other auxiliaries.
6.	Power supply requirements with load <ul style="list-style-type: none"> • Power Supply: • Rated Capacity: • Power Consumption (Max/Operation): • Power Consumption (Min/Standby):
7.	Drawing of loose parts showing maintenance space requirement and preferred location onboard including installation constraints, if any
8.	List of equipment and accessories not included in the scope of supply but required for the proper functioning of the system
9.	Format for I/O List
10.	Draft QAP / IN approved QAP

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1.5.7 Following Binding Data delivery schedule shall be followed:

Sl. No	Drawings & Documents	Delivery Time (From PO)
Essential Binding Data		
1.	Binding data including dimensions, footprint, power Supply requirements and Maintenance Envelopes for equipment	4 weeks after placement of PO
2.	BOM and weight details including Center of Gravity of the equipment	4 weeks after placement of PO
3.	IPMS Network and Hardware	4 weeks after placement

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	Layout, Architecture with Functional block diagram along with recommended types and sizes of Cables	of PO
4.	Schematic drawing along with recommended Types and sizes of Cables	4 weeks after placement of PO
5.	Heat Dissipation details for all equipment	4 weeks after placement of PO
6.	Sensor and Junction Box dimension and Wiring Diagram, EOT/POT Wiring Diagram	4 weeks after placement of PO
7.	List of equipment with identification of the manufacturer, type and model.	4 weeks after placement of PO
8.	QAP for approval	4 weeks after placement of PO
9.	IO list Finalization	6-12 weeks after placement of PO (and 2 weeks post receipt of design inputs from Shipyard)
10.	IWD of Consoles, hardwire panel, RTUs and other equipment	12 weeks after placement of PO/ 2 weeks post binding data approval
11.	IPMS Failure Mode and Effects Analysis (F.M.E.A.) document	14 weeks after placement of PO/ 2 weeks post binding data approval
12.	Terminal Connection Diagram	14 weeks after placement of PO
13.	Class Approved Documents	8 weeks prior to FAT
14.	Details of Shock mount with dimension detail, fasteners details, material specifications, free height with tolerance, maximum full load deflection with tolerance, maximum load bearing capacity shelf life & operating life of the mounts are required to be furnished in document.	2 weeks after finalization of dimensions, footprint and weight of equipment.
Certificates		
15.	Certificates / QAP test reports	2 weeks prior FAT
16.	Manufacturer test certificates /	Along with delivery

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	Class certificates	
Documents/Manual		
17.	Test & Trial Plan (FAT, HAT & SAT)	16 weeks Prior to FAT
18.	Installation manual	8 weeks after placement of PO
19.	Technical manual, Operational guide, Maintenance manual	6 weeks before Delivery
20.	Maintenance schedule giving details of tasks to be performed during equipment servicing	6 weeks before Delivery
21.	Part manual	6 weeks before Delivery

1.5.8 Certificates:

- OEM should obtain complete system approved by ABS class as per the indicated applicable notations in Para 1.7.1. The system is to be Unit Certified by ABS. OEM will give type tested equipment or carry out type tests to meet requirements indicated in SOTR.
- The certificates should be delivered as applicable and as required by Classification Society.
- Any document, certificate and clarification asked by class/Indian navy during construction and trials of the vessels are to be furnished by OEM for the equipment, auxiliaries and loose parts supplied, up to the satisfaction of the class.
- All certificates should be delivered in one (01) original and four (04) hard copies and one (01) No. soft copy. All Certificates to be provided in English language.
- Calibration certificates to be provided having validity not less than 12 months post commissioning of the ship.

1.6 Testing /Trials and Inspection

1.6.1 Factory Acceptance Tests (FATs)

- Factory Acceptance Test (FAT) program shall be performed for each Equipment/System, for all ship sets.
- The FAT protocol is to be communicated to Indian Navy through Shipyard for approval as per timelines specified in Para 1.5.7 for conduct of FATs. Entire system will be tested at IFATS with simulated inputs and same shall be included in trial protocol.
- Owner has the right to witness these FATs and will be invited with a minimum of six (6) week notice. The Client / Owner have the right to

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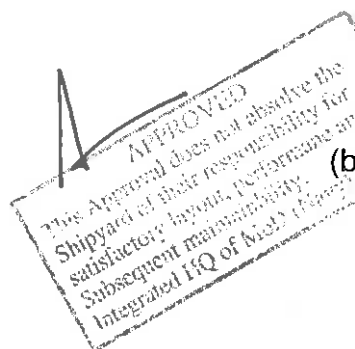


undertake inspection and survey of system, accessories, equipment, and paint work at Maker's and Subcontractor's premise

- (d) Complete set of tools, documents, of the equipment being supplied will be made available prior conduct of FATs. Final Draft of the following documents are to be submitted for inspection by FAT team prior conduct of FATs:-
 - (i) Test procedure and documentation.
 - (ii) Calibration certificates, as applicable.
 - (iii) TNC MoM.
 - (iv) Technical and Operating Instruction manual.
 - (v) Parts & tools catalogue.
 - (vi) Installation Drawings
 - (vii) Confirmation to standards specified.
- (e) Entire system will be tested during IFATS with simulated inputs and same shall be included in trial protocol
- (f) Final Dispatch clearance will be accorded by IN

1.6.2 Testing/Trials (HATs/SATs)

- (a) OEM to Prepare General Requirement for Assurance of Quality (GRAQs) for onboard setting to work and trials of the equipment for approval by Indian Navy. It should include following:
 - (i) Installation & Alignment Checks
 - (ii) Safety Devices Checks (Cold & Hot)
 - (iii) Checks during Basin Trials
 - (iv) Checks during Sea Trials
 - (v) Functionality Test.
- (b) Test/trial of the equipment to be carried out as per ABS International Naval rule requirements and IN approved GRAQs in the presence of Shipyard/ABS/IN. The Draft GRAQ for IPMS will be prepared by Shipyard in consultation with OEM and will be submitted to IN for approval as per 'DME 303 D – Guidelines for Acceptance Trials of Main and Auxiliary Machinery for New Construction Ships'.
- (c) **Responsibilities and Witnessing Trials.** The responsibility for offering the Trials is of the OEM. Witnessing agency and personnel for witnessing trials will be in accordance with the IN approved FATs protocol and GRAQs



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1.7 Rules, Regulations, References and Standards applicable for the vessel

1.7.1 The vessel will be constructed in accordance with the rules and regulations and under the survey of ABS with the following class notation:

+ A1, (E), GOVERNMENT SPECIAL SERVICE, SFA (30), SH-DLA, AB, COMF, CRC (SC), HELIDK, UWILD, UNREP, +AMS, +ACCU, +DPS2

1.7.2 Ship will be classified under ABS International Naval ships rules 2021. Any other requirement of classification society should be met, approval obtained and items to be supplied along with necessary documents and certificates by the supplier.

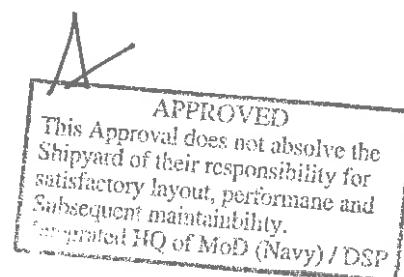
1.7.3 The Vessel and its equipment shall be designed and built in accordance with International Shipbuilding Standards in respect of general hull, marine engineering and electrical equipment and International Rules and Regulations and comply with the below mentioned as a minimum.

(a) Classification Society Rules and Regulations according to class notations.

(b) The International Convention for Prevention of Pollution from Ships, 1973 and Protocol 1978, MARPOL 73/78.

(c) International Convention on Load lines, 1966 and the International Convention on Tonnage Measurement

(d) Any explicit requirement stipulated in Chapter 2&3



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CHAPTER 2- TECHNICAL REQUIREMENTS

2.1 Function and Performance

The Integrated Platform Management System (IPMS) will be dual redundant Gigabit optical fiber network, distributed architecture controlling and monitoring the machinery (Main Propulsion Components, DAs, and auxiliaries) and ship systems including damage control systems. The purpose of the integrated system will be to provide control and monitoring of the propulsion machinery, power generation and distribution, auxiliary machinery and Damage control (NBCD) machinery and systems through corresponding sub-systems. This will be a proven decentralized, marine type, open architecture Automation System that will be utilized for remote control and monitoring. IPMS will comprise following systems:

- 2.1.1 Integrated Machinery Control System (IMCS)
- 2.1.2 Auxiliary Controls System (ACS)
- 2.1.3 Battle Damage Control System (BDCS)
- 2.1.4 CCTV Monitoring & Control (Visual monitoring of machinery spaces)
- 2.1.5 Equipment Health Monitoring(EHM) Module, including Vibration Trend Monitoring
- 2.1.6 Onboard Training System/Simulator (OBTS)
- 2.1.7 Built-in test equipment (BITE)
- 2.1.8 Artificial Intelligence/Machine Learning enabled Decision Making Module
- 2.1.9 Engineers' Alarm System

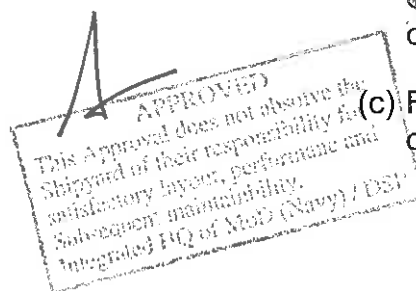
2.2 Applicable Standards for the Equipment/System

- 2.2.1 ABS Naval Rules for +ACCU Notation
- 2.2.2 ABS compliance statement for Onboard Stability Software
- 2.2.3 EED-50-77 for UPS
- 2.2.4 JSS 55555 for RTUs and Consoles as per Para 2.15.2
- 2.2.5 MIL STD – 461 E/F for RTUs and consoles as per Para 2.15.2

2.3 Redundancy, Back Up Supply, Data Logging Capacity and Growth Margin

2.3.1 Redundancy

- (a) Gigabit optical fibre network should be dual redundant.
- (b) Control system survivability to be increased through redundancy of critical components especially at RTU level for Propulsion machinery/ critical machineries iaw Para 2.4.12.
- (c) Following Critical machinery sensors and actuators are to be connected to more than one RTU :-
 - (i) Propulsion and associated auxiliaries
 - (ii) Power generation machinery and associated auxiliaries
 - (iii) Ref/ AC Plant



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All required splitters for meeting this requirement shall be provided by IPMS Supplier.

(d) Provide interchangeability of cards to other similar units and perform the function at the new unit without any software changes.

(e) Provide proven multifunction and fully redundant consoles which can assume any and all monitoring and control functions.

(f) Propulsion control system to be designed such that there are no common modes of failure of active components which can result in the loss of both port and starboard propulsion at the same time. System FMEA to be proved in sea trials verifying this functionality

2.3.2 Back up Supply: Complete IPMS system should be powered from UPS of adequate capacity catering for a backup period of 30 Mins. Totally approx. 04 or 06 in Nos. of Online UPS are to be considered based on the Power distribution Group and DP configuration. The system shall be provided with main and alternate source of supply. The UPS shall be installed in air-conditioned spaces.

2.3.3 Data Logging: Each console shall be capable of data logging upto a minimum period of six months of machinery operation. Data Logging shall include time stamp.

2.3.4 Growth Margin: A growth margin of 25% of the system capability without the addition of new consoles and RTUs to be provided.

2.3.5 The IPMS supplier will be responsible for resolving all interface issues with other machinery and equipment suppliers under the Control and Monitoring of IPMS. All P&I Diagrams, Control and Monitoring Function Documents etc. are to be discussed with the respective equipment OEMs and their concurrence obtained.

2.3.6 The IPMS supplier will also submit a Certificate for No Malicious Code in respect of embedded software.

2.4 Design, Construction and configuration, mounting Arrangements

2.4.1 IPMS Design shall be based on VME 64 open architecture and not proprietary designs such as PLCs.

2.4.2 Client-server architecture shall not be used. Except for the Windows family of operating systems, the equipment hardware and software shall be compliant to open architecture standards and strictly not include any proprietary interfaces or operating systems.

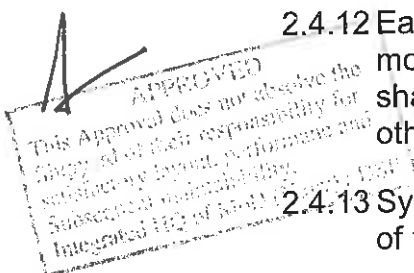
2.4.3 Multi-Functional Consoles (Operator Work Station) shall be provided in Single/Dual/Three bay configurations.

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- 2.4.4 The Human Machine Interface (HMI) is to consist of high resolution colour graphics display units. Console screens shall have a minimum diagonal size of 22-inches with a minimum resolution of 1920 x 1080 pixels.
- 2.4.5 The HMI shall also provide audible and visual indications of alarms and warnings. Separate audible tones shall be used to indicate the various status alerts, alarm and warning conditions. Acknowledgement of the alarm or warning shall cause the audio alarm to be silenced.
- 2.4.6 The total number of signals required to be interfaced with IPMS shall be approximately 3000 to 4000. Final I/O list shall be jointly finalized by IPMS supplier, interfaced equipment suppliers and Shipyard. The I/O List to be submitted to Shipyard and Class as part of the approval process by IPMS Supplier.
- 2.4.7 The system shall provide control and monitoring capability to the operators through colour mimic page displays. The use of traditional dials and gauges in the IPMS shall be restricted to hardwire signals related to Main Propulsion Plant and Power Generation Machinery only as specified in Para 2.6 of this Technical specification.
- 2.4.8 The IPMS components shall be geographically distributed throughout the ship and in close proximity to the machinery being controlled.
- 2.4.9 All monitoring and control signals shall be communicated over the data bus. The system topology shall have a dual redundant data bus with recovery features in the event of failure of either of the two redundant buses.
- 2.4.10 The IPMS shall have a two level architecture with a supervisory level comprising multi-function redundant consoles, and a data acquisition and control level comprising the Remote Terminal Units (RTUs). The data acquisition and control level shall not have multiple levels in order to minimize data latency and reduce maintenance. All the logics for control of the equipment shall be at RTU level.
- 2.4.11 Remote Terminal Units (RTU) shall use open architecture VME 64 VITA compliant cards.
- 2.4.12 Each RTU shall have a microprocessor based cards for control and monitoring purpose. Propulsion control and Power generation RTUs shall have dual redundant processor and power supply modules. All other RTUs shall have redundant power supply cards.
- 2.4.13 System shall provide for graceful degradation in the event of total failure of the control system.
- 2.4.14 Access to the platform functions shall be based on a pre-determined protocol (designated Station-in-Control).



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- 2.4.15 All Consoles and RTUs should meet JSS 55555 requirements.
- 2.4.16 Self-sustained, independent, built-in cooling arrangements for RTUs to be provided to ensure trouble free operation of RTUs.
- 2.4.17 The IPMS for the first ship shall comprise of a reference system for the Naval Dockyard as follows:

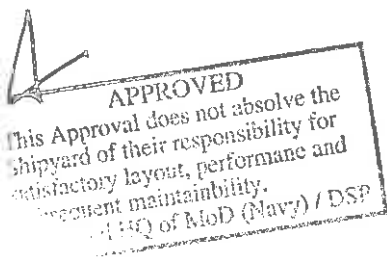
(a) Configuration: -

- (i) Computers loaded with application software – 01 no.
 - (ii) Monitor – 01 No.
 - (iii) Keyboard – 01 No.
 - (iv) Mouse – 01 No
- (b) Computer Aided Test Facility: -
- (i) Test Bench with power supply – 01 No.
 - (ii) Card cages compatible with all type of cards – 01 No.
 - (iii) One in no. of each type of card as per IPMS configuration

2.4.18 Inter-changeable IPMS control consoles shall be provided at the following locations:-

(a) MCR:

- (i) One (01) console for control and monitoring of propulsion and associated systems (Propulsion Control Console) including telegraphs (EOT/POT), and facility for automatic data logging of engine/propeller orders. Embedded telegraphs shall be provided additionally. The Human Machine Interface(HMI) shall be capable of permitting single console with two split screens (one console with two display screens) only for main propulsion control operation in times of normal peacetime cruising, and full watch operation at higher levels of readiness. Additional space to be catered in console for fitment of Yard items.
- (ii) One (01) Console for control of Auxiliary Machinery (ACS Console)
- (iii) One (01) Supervisory Control Console
- (iv) One (01) Large COTS Screen Display of 55 inches, touch Enabled.



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- (b) Bridge: One (01) Bridge Control Console for control and monitoring of main propulsion machinery including telegraphs (EOT/POT) and facility for automatic data logging of engine/propeller orders. Embedded telegraphs shall be provided additionally. Only equipment will be in the scope of supply of IPMS Vendor, console carcass will be as part of IBS vendor.
- (c) OPS Room: One (01) Multifunctional console in the Ops Room for monitoring of Main propulsion Machinery including telegraphs (EOT/POT) and facility for automatic data logging of engine/propeller orders. Embedded telegraphs shall be provided additionally.
- (d) DCHQ: Shall be provided with One (01) BDCS console.
- (e) Alternate DCHQ: Shall be provided with one (01) BDCS Console
- (f) Section Bases: Compact Bulkhead mounted BDCS consoles shall be provided for FWD Section base & AFT Section Base.

2.4.19 Engine Order Telegraph: Electronic Engine Order Telegraph (EOT)/ Revolution Order Telegraph (ROT) and Emergency EOT shall be provided on IPMS panels/Consoles with auto logging facility between bridge, MCR, emergency propulsion control post at engine room.

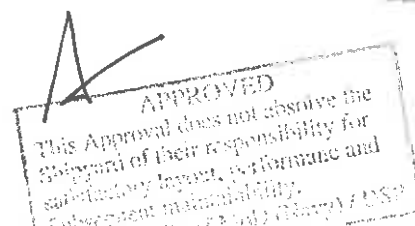
2.4.20 Preliminary Design Review (PDR) and Critical Design Review (CDR) to finalize the software and hardware configuration during the execution stage need to be conducted by IPMS VENDOR with IN and Shipyard, and forward the Review Report at the earliest following each design review.

- (a) Preliminary Design Review – Shall be conducted at the earliest from the placement of Order.
- (b) Critical Design Reviews - Shall be conducted at the earliest post Preliminary Design Review

2.5 Modes of Operation

2.5.1 Remote Control System of Propulsion

- (a) The IMCS of IPMS shall be the Remote Control System of Propulsion drive train. Propulsion drive train consists of the following equipment/system.
 - (i) Main Engine – 02 Nos.
 - (ii) Gear Box – 02 Nos.
 - (iii) Shafting – 02 Nos.
 - (iv) CPP – 02 Nos.



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- (b) The control of the propulsion plant shall be based on the combinator control i.e. by means of a Hardwired/ Software based EOT/ POT for each shaft line. The combinator curves shall be programmed in to the system for each of the operational modes of the propulsion plant. Whilst operating in fully automatic mode the IPMS shall be capable of directly controlling the Port and Stbd Propulsion train either linked or unlinked. Propulsion shall operate in constant speed or in combinatory mode as given below:
- (i) Constant RPM Mode: In this Mode Main Engine shall be operating in the Engine's Rated RPM constantly. The speed of the vessel is controlled by controlling the propeller pitch.
- (ii) Combinatory Mode: In this mode both RPM of the Main Engine & propeller pitch are controlled based on the combinatory curve. Final combinatory curve shall be provided by CPP shafting supplier and shall be implemented in IPMS software.
- (c) Following operating modes related to the propulsion system shall be available:
- (i) Main Engine driving propulsion
 - (ii) Main Engine driving propulsion and FiFi pump
 - (iii) Main Engine driving FiFi pump alone
 - (iv) Single engine running with other shafting in locked position.
 - (v) Single engine running with other shafting in trailing position.
 - (vi) Towing
- (d) In addition to the above modes, each Propulsion drive train is integrated with the DP system for DP mode & Joystick Mode. In DP mode & Joystick mode, the propulsion drive train will always operate in the constant RPM. Interface requirement is specified in Para 2.6.10

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Note: DP system is not part of IPMS vendor supply

2.6 Interface definition and protocol: Equipment suppliers shall provide necessary I/O signals and interface definition as mutually agreed with IPMS supplier and shipyard. Interface meetings will be scheduled with the equipment suppliers, shipyard and IPMS supplier to finalize relevant interfaces, signal format. These requirements defined during the interface meetings and finalized therein shall be taken care in the IPMS system. The IPMS supplier shall accordingly generate an Interface Control Document (ICD) based on final design configuration, post CDR.

2.6.1 Main Engine:

- (a) Engines will be capable of being started and stopped from both remote and local positions i.e. IPMS console in MCR and engine

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rooms. Remote control & monitoring of Main Engine shall be carried out by IPMS through serial links, and hardwired input/output for necessary critical parameters. The propulsion system of the vessel will be able to be controlled from Bridge and MCR through IPMS. The use of hardwired instrumentation shall be minimized and will be as required by ABS/DefStan 313 and Build Specifications. The following signals will be hardwired to MCR:

- (i) Start
- (ii) Stop
- (iii) Emergency stop
- (iv) ME Safety Override
- (v) ME Remote indication
- (vi) ME Ready to start indication
- (vii) ME Common Alarm
- (viii) RPM Increase/ decrease command
- (ix) Engine RPM indication
- (x) ME Lub Oil Pressure

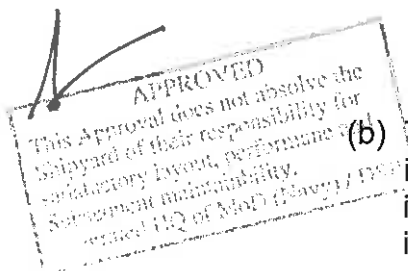
- (b) Necessary splitters for hardwire and Multifunction console (MFC) controls has to be provided by IPMS OEM.

2.6.2 Gear Box:

- (a) Remote control & monitoring of Gear Box shall be carried out by IPMS. This shall include the remote monitoring of all gearbox bearing temperatures at IPMS console in MCR along with warnings and alarms for temperature exceeding normal operation limits. The use of hardwired instrumentation shall be minimized and will be as required by ABS/DefStan 305 and Build Specifications. Following signals will be hardwired to MCR:-

- (i) Clutch
- (ii) Declutch
- (iii) MD Stand By Lub Oil Pump (Start/ Stop)
- (iv) RG Common Alarm
- (v) RG control local/ remote indication
- (vi) RG ready to clutch-in indication.
- (vii) RG Lub Oil Pressure

- (b) The operating position of turning gear (Engage/ Disengage) will be indicated both locally and in MCR. All gearbox parameters will be interfaced with IPMS. In case turning gear is engaged, IPMS to indicate engine not ready to start and engine start option is to be disabled at IPMS.



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- (c) The operating position of the manual locking device will be indicated both locally and in MCR. A safety interlock will be provided to prevent operation of the engine/ gearbox when the locking device is engaged.
- (d) Necessary splitters for hardwire and MFC controls has to be provided by IPMS OEM.

2.6.3 Shafting & CPP:

- (a) Remote control & monitoring of Shafting & CPP shall be carried out by IPMS. The use of hardwired instrumentation shall be minimized and will be as required by ABS/DefStan 304 and Build Specifications. Following signals will be hardwired to MCR:-
 - (i) Pitch indication
 - (ii) Shaft RPM
 - (iii) Pitch Increase
 - (iv) Pitch Decrease
 - (v) Hydraulic Pump Controls
 - (vi) Hydraulic Oil Pressure
 - (vii) Shaft Brake (Engage/ Disengage)
 - (viii) CPP controls remote/ local indication
- (b) Necessary splitters for hardwire and MFC controls has to be provided by IPMS OEM.

2.6.4 Propulsion control :

- (a) A common hardwired panel shall be provided by IPMS supplier for main engine, gear box, Shafting & CPP as defined in Para 2.6.1, 2.6.2 and 2.6.3.
- (b) Facility for switching control from IPMS MFC to this common hardwired panel shall be provided on the Propulsion Control Console.
- (c) There shall be a facility of automatic transfer of control to Hardwire panel from IPMS MFC, in case of failure of IPMS.

2.6.5 Steering Gear: Remote monitoring of steering gear pumps and control systems including all parameters, alarms and indications shall be available through IPMS.

2.6.6 Diesel Alternator: Remote control & Monitoring of Diesel Alternators (04 Nos.) shall be carried out by IPMS through serial links. The DA LCP will have provision for selection of 'Local' or 'Remote' control. On selection of 'Remote', the control shall be exercised through APMS. However start/stop operation will also be possible from IPMS. The standby DA available to APMS will be designated from IPMS. Facility will be

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provided for remote starting of DG sets from Machinery Control Room (MCR) through IPMS. Alarms and Warnings will be provided for safe operation of the DA and indications for these will be provided locally, at the switchboards and in MCR. Hardwiring of essential signals for control and monitoring is to be available on IPMS as per class requirements. Following signals will be hardwired:-

- a) Start
- b) Stop
- c) Emergency Stop
- d) DA Remote indication
- e) DA Standby
- f) DA Common Alarm
- g) DA RPM indication
- h) DA LO Pressure

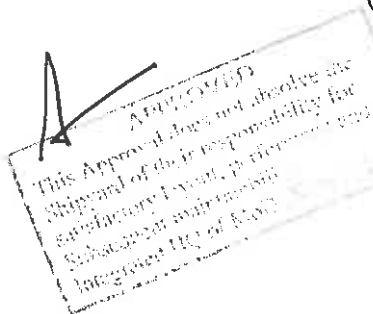
2.6.7 Automated Power Management System (APMS):

(a) The APMS shall be suitably interfaced with IPMS (Through Gateway provided by IPMS supplier) and switchboards. The exact protocol shall be finalized during detail design. IPMS shall have the following functions but not limited to:-

(i) IPMS shall have the details of APMS operation Modes (Manual/Semi-Automatic (Assisted)/Automatic).

(ii) IPMS shall be able to designate the sequence of 'Stand by DA' (Since running hours, Maintenance requirements and availability of Engine is controlled from MCR).

(iii) In Auto Mode of APMS, APMS will initiate the start command of the DG based on the platform power supply requirement. The number of starts shall be restricted as per the DG OEM recommendations. If the 1st standby DA fails to start then 2nd standby DA shall be automatically started by APMS. The IPMS will be provided a control for the operator in MCR to designate which generators are available for operation. Similarly for stopping, APMS shall send the stop command to the DG LOP. IPMS shall also have the facility to start and Stop the DG.



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- (iv) In Manual and Semi-Auto (Assisted) Mode, operator in switchboard room shall control the start/stop control of the main DG. The IPMS will be provided a control for the operator in MCR to designate which generators are available for operation. IPMS shall also have the facility to start and Stop the DG.
- (v) IPMS shall display the switchboard parameters such as Load, frequency, Voltage, etc.
- (vi) In addition to the above, the generator/ alternator related parameters of all the DGs like alternator bearing temperature, alternator winding temperature etc., as applicable, should be provided to APMS from IPMS.
- (b) All Interfaces and protocols shall be discussed and mutually agreed between IPMS, APMS & DA Suppliers.

2.6.8 Auxiliary Control Systems

- (a) Hydrophore System: The Hydrophore system with associated fresh water pumps shall be interfaced for remote operation through IPMS.
- (b) Refrigeration plant
 - (i) Temperature readings of the refrigerated compartment shall be integrated for display in IPMS. In case of a rise in temperature above the stipulated limit, an alarm shall be provided in IPMS. All sensors necessary for this shall be in the scope of Refrigeration plant OEM.
 - (ii) Commencement and termination of the defrosting cycle will be indicated on the local control panel as well as on the IPMS.
- (c) Man trap alarm system: Mantrap alarm for all cold/cool rooms to be interfaced with IPMS for display on all IPMS consoles.
- (d) RO Plant: IPMS shall integrate with RO Plant for indications of plant operation and faults. Individual alarms shall be provided for RO Plants on the IPMS and not a common alarm.
- (e) Purifiers: IPMS shall integrate with Oil Purifiers for monitoring as well as fault indications.
- (f) Air receivers: IPMS shall be connected with pressure sensors of Air receivers for monitoring and initiate low pressure alarms in case the pressure in any cylinder falls below the minimum permissible limits.

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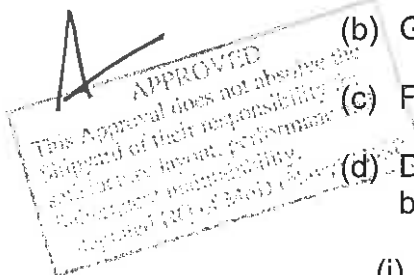
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- (g) Pumps and Starters: IPMS shall integrate with pumps starters for control & Monitoring as per Para 2.6.11
- (h) Remote operated valves : IPMS shall be able to monitor & control the remote operated valves of various systems as per Para 2.6.11
- (i) Fire main system
 - (i) Fire main isolating valves and fire pump suction and discharge valves will be remotely operated through the IPMS
 - (ii) Fire main pressure indicator of all sections will be available at IPMS
- (j) Fuel Oil system
 - (i) FO system is integrated with IPMS to enable monitoring and remote operation of all system valves.
 - (ii) IPMS shall monitor the flow meters of Fuel oil System.
- (k) MD-Air Compressors: IPMS shall integrate with MD-Air Compressors for indications of plant operation and faults. Individual alarms shall be provided for MD - Air Compressors on the IPMS and not a common alarm.
- (l) AC Plants: IPMS shall integrate with AC Plants for indications of plant operation, faults and Chilled Water/ Sea Water Pump. Individual alarms shall be provided for AC Plants on the IPMS and not a common alarm.
- (m) Integration with other systems shall be finalized during the preparation of I/O List.

2.6.9 Battle Damage Control System : The battle damage control system shall be integrated with the following

- (a) HVAC system for control and monitoring in line with Total Atmospheric control system (TACS).
- (b) Galley Fire-fighting system for status & operation monitoring.
- (c) Fixed firefighting system for status & operation monitoring.
- (d) Door & hatch monitoring sensors for status monitoring as mentioned below:-
 - (i) Status (Open/ Close) of doors and hatches using sensors shall be available in IPMS System. Sensors are not part of IPMS supplier's



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scope of supply. The interface shall be finalized at the detailing stage.

- (ii) Approximately 16 in nos. of Connection Boxes to be provided by IPMS supplier for Status monitoring in IPMS as well as to facilitate darken ship condition for white/ red lights.
- (e) NBC ventilation system for remote operation.
- (f) SICADS & SIRS for alarm monitoring.

2.6.10 DP System

- (a) IPMS shall be integrated with DP system for control of propulsion system during DP operational Modes. Entire propulsion train shall be in Constant RPM mode during DP operational modes. The manual/ DP/ Independent joystick selector switch of DP system is located on the Bridge adjacent to the DP Control Console. The remote control system of the propulsion system i.e. the IPMS will provide separate "DP Ready" signals for Port and Stbd propulsion trains indicating that the propulsion control is ready to be taken over by the DP system. On selection of the DP mode, a "Control Request" is sent to the IPMS and the main propulsion controls is shifted from manual control levers to the DP control system. Following are the minimum List of interfaces for each propulsion train but not limited to:

(i) DP System

- (aa) Control request From DP – Input to IPMS
- (ab) Ready for DP – Output from IPMS
- (ac) Pitch Demand from DP – Input to IPMS
- (ad) Pitch feedback to DP – Output from IPMS

(ii) Joystick System (JS)

- (aa) Control request From JS – Input to IPMS
- (ab) Ready for JS – Output from IPMS
- (ac) Pitch Demand from JS – Input to IPMS
- (ad) Pitch feedback to JS – Output from IPMS

2.6.11 The tentative list of interface requirement for equipment/systems, but not limited to, is given below:-

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S.NO	SYSTEMS	INTERFACE	
		CONTROL	MONITORING
	PROPULSION		
1.	MAIN ENGINE	✓	✓
2.	GEAR BOX	✓	✓
3.	SHAFTING & CPP	✓	✓

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S.NO	SYSTEMS	INTERFACE	
		CONTROL	MONITORING
4.	MAIN DG SYSTEM	✓	✓
5.	EDG SYSTEM	X	✓
6.	THRUSTERS	X	✓
7.	STEERING GEAR	X	✓
8.	STABILISER	X	✓
	<u>FUEL OIL SYSTEM</u>		
9.	FO TRANSFER PUMP	✓	✓
10.	SLUDGE TRANSFER PUMP	X	✓
11.	FO PURIFIER	X	✓
12.	REMOTE OPERATED VALVES AND FLOWMETERS	✓	✓
	<u>FRESH WATER SYSTEM</u>		
13.	FRESHWATER PUMP	✓	✓
14.	HW CIRCULATION PUMP	✓	✓
15.	RO PLANT	✓	✓
16.	HYDROPHORE TANK (for fresh water Pump)	✓	✓
17.	REMOTE OPERATED VALVES	✓	✓
	<u>COMPRESSED AIR SYSTEM</u>		
18.	AIR COMPRESSOR	X	✓
19.	SYSTEM VALVES AND OTHER RELATED INSTRUMENTATION	X	✓
	<u>BILGE SYSTEM</u>		
20.	BILGE PUMPS	✓	✓
21.	OWS	X	✓
22.	REMOTE OPERATED VALVES AND RELATED INSTRUMENTATION	✓	✓
23.	BILGE SENSORS	X	✓
	<u>AVCAT SYSTEM</u>		
24.	AVCAT PUMPS	X	✓
	<u>BALLAST SYSTEM</u>		
25.	BALLAST PUMPS	✓	✓
26.	SYSTEM VALVES AND OTHER RELATED INSTRUMENTATION	X	✓
	<u>SEA WATER SYSTEM</u>		
27.	PROPULSION COOLING PUMP	✓	✓

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Subsequent MR of Main Engine
Image: 117 of Main Engine

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S.NO	SYSTEMS	INTERFACE	
		CONTROL	MONITORING
28.	SW PUMP FOR AC PLANT & REF PLANT	✓	✓
29.	REMOTE OPERATED VALVES AND RELATED INSTRUMENTATION	✓	✓
	<u>FIRE MAIN SYSTEM</u>		
30.	FIRE PUMPS	✓	✓
31.	REMOTE OPERATED VALVES AND RELATED INSTRUMENTATION	✓	✓
32.	SALVAGE PUMP	✓	✓
	<u>FIRE FIGHTING SYSTEM</u>		
33.	FIXED FIRE-FIGHTING SYSTEM	X	✓
34.	LOCAL WATER MIST SYSTEM	X	✓
35.	GALLEY FIRE-FIGHTING	X	✓
36.	SPRINKLING SYSTEM	X	✓
37.	PREWETTING SYSTEM	✓	✓
38.	MAGAZINE FIRE FIGHTING SYSTEM	X	✓
39.	AFFF SYSTEM	X	✓
40.	DP SYSTEM	✓(*)	✓
	<u>OTHER AUXILIARIES</u>		
41.	STP & VTS	X	✓
42.	INCINERATOR	X	✓
43.	QCV SYSTEM- QUICK CLOSING VALVE SYSTEM	X	✓
44.	EX-FIFI	X	✓
45.	ICCP	X	✓
	<u>HVAC & Ref</u>		
46.	AC PLANT	✓	✓
47.	REF PLANT	✓	✓
48.	CHILLED WATER PUMP FOR AC PLANT	✓	✓
49.	ATU,FCU,HE, AFU, SW/CW COOLERS	✓	✓
50.	VENTILATION SYSTEM (GAS TIGHT DAMPER, VENTILATION FANS, AND VALVES AS APPLICABLE)	✓	✓
	<u>ELECTRICAL SYSTEMS</u>		
51.	APMS (Through Gateway)	✓	✓
52.	CCTV-MACHINERY	✓	✓

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S.NO	SYSTEMS	INTERFACE	
		CONTROL	MONITORING
53.	TANK LEVEL SENSORS	X	✓
54.	AFDS	X	✓
55.	AFAS	X	✓
56.	LOCKED IN ALARM-COOL/COLD ROOM	X	✓
57.	DOOR AND HATCH SENSORS	X	✓
58.	SIRS	X	✓
59.	SICADS	X	✓
60.	MBSRE	X	✓
61.	PGD	X	✓
62.	LO Purifier	✓	✓

* - Represents propeller control (through IPMS) from DP system

2.6.12 Additionally, the following systems shall be interfaced with IPMS for data exchange:

- (a) IBS (through gateway provided by IPMS supplier)
- (b) SDN (through gateway provided by IPMS supplier)
- (c) VDR (data flow from IPMS to VDR for recording)

2.7 Space, Weight and Size

Vendor to provide the dimension and weight details for all the deliverables along with the technical offer.

2.8 Physical and material characteristics, surface coating, painting

Painting: The paint is to be suitable for the equipment to operate without restrictions in tropical region. Painting for Electrical equipment shall conform to DGS 251/Marine standard. The applicable colour code RAL 7001/ LAG as per BS 381C / IS5-colour code 632 (DAG)/ OEM standard to be adhered.

Material: Consoles and RTUs enclosures should be made of material suitable for usage in marine environment.

2.9 Maintainability, Availability, Reliability

2.9.1 All machinery, sensors and equipment should have reliability and maintainability for a mission time of 60 days at a stretch.

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- 2.9.2 Modular replacement be considered to the maximum extent possible to perform corrective maintenance or repair actions.
- 2.9.3 The Repair by Replacement concept is to be ensured for onboard maintenance, while optimizing cost-effectiveness.
- 2.9.4 BITE (Built-in Test Equipment) for onboard systems and equipment are to be provided wherever possible.
- 2.9.5 Mean Time between Failure (MTBF): Supplier to provide the value
- 2.9.6 Mean Time to Repair (MTTR): Supplier to provide the value

2.10 Operation Cycle, Operational Life

Product life shall be minimum of 30 years excluding electronic equipment for which the minimum period would be 10 years.

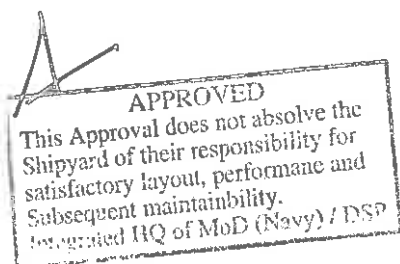
2.11 Control System and Monitoring

2.11.1 Integrated Machinery Control System(IMCS)

- (a) IMCS shall control and monitor the Main & Aux propulsion plant consisting of two shaft sets, Main Diesel Engines, Reduction Gear Boxes, clutches, shafting, stern seals, shaft line load bearing members like thrust blocks, plummer blocks, stern tubes and shall have provision for online vibration monitoring.
- (b) Propulsion control shall be carried out from IPMS MFCs and hardwired panels. Facility for switching controls between MFCs and the hardwired panel (at MCR) shall be provided. Necessary splitters for hardwire and MFC controls shall be provided by IPMS OEM. There shall be a facility of automatic transfer of control to Hardwire panel from IPMS, in case of failure of IPMS network components or HMI.

2.11.2 Auxiliary Control System(ACS)

- (a) ACS shall control and monitor the auxiliary machinery and systems which includes tank level monitoring system (Scope of IPMS Vendor Supply) as specified in Annexure 2. For interface requirements of below mentioned systems, refer Para 2.6.11
 - (i) AC plants
 - (ii) Refrigeration Plants
 - (iii) Air compressors
 - (iv) Reverse Osmosis Plants (With motorized valves to control the flow of water to the tanks. Valves not in scope of IPMS supplier)
 - (v) Steering gear & Stabilizers
 - (vi) Oily water separator



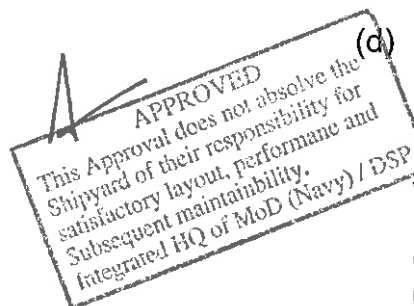
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- (vii) Centrifuges
- (viii) Fuel system including ship fueling at harbor/sea (with motorized operation of all fueling valves. Valves not in scope of IPMS Supplier)
- (ix) Lube oil pumps
- (x) Bilge & Ballast Systems
- (xi) Fresh Water pumps with hydrophore tanks
- (xii) Sea water system including firemain and cooling water suction, discharge and section isolating valves
- (xiii) Aviation fuel system (Monitoring only)
- (xiv) Compressed air systems including monitoring of receiver air pressures
- (xv) Machinery compartment ventilation and cooling systems
- (xvi) Fuel, Oil, water, AVCAT transfer systems
- (xvii) Status of sea water suction valves (Motorized operation)
- (xviii) Tank level indication system (TLI) for all onboard tanks (a real time operation system)
- (xix) Sea water cooling system of stern tube (pressure & flow rate)

2.11.3 Battle Damage Control System(BDCS)

- (a) BDCS shall be a centralized station to control and monitor all damage control machinery, equipment and systems (DC and FF) including Automatic/Addressable Fire detection System (AFDS), Flood alarm systems including low and high level alarms and NBCD systems. Its control architecture will be distributed digital architecture.
- (b) BDCS shall assist the ship's damage control officer in his decision making process during damage control operations. This assistance shall include functions such as the evaluation of ship stability with recommendations for counter-flooding or ballasting, firemain reconfiguration and section isolation based on the damage assessment, threat perception and damage control status.
- (c) The BDCS shall include Fire Main, salvage, Flood alarm system, Automatic/Addressable Fire detection, onboard stability Management System and monitoring of status of doors and Hatches.
- (d) BDCS shall be updated by the vendor to reflect the "As Delivered State" of the ship. BDCS System should be part of IPMS. Display panel to be provided in DCHQ, Alternate DCHQ and Section Bases as indicated in Para 2.4.18. Following systems shall be integrated with BDCS:-
 - (i) Galley Fire Fighting System
 - (ii) Fixed Fire Fighting system for Bosun stores, inflammable stores, paint stores, etc.



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- (iii) Operation of fire main pumps, salvage pumps, ballast/de-ballast pumps, etc.
 - (iv) Pre-wetting system
 - (v) Flood alarm system
 - (vi) Addressable fire detection system
 - (vii) 'Door and Hatch' open alarm system
 - (viii) Ventilation control system
 - (ix) Ship online stability Monitoring System with Stability software
 - (x) SICADS and SIRS alarm
 - (xi) Compartment layout and kill cards
 - (xii) Dynamic Kill cards
 - (xiii) The BDCS displays shall provide the ship's plan views and isometric views and display all firefighting, damage control and NBC status information thereon. The information shall be displayed in a user friendly manner using graphical tools such as layers, tiles, icons, drawing tools, zoom/magnifying tool, pan etc. A summary display window shall also show the status of all major equipment and systems.
- (e) Dynamic Kill Cards: The BDCS System shall include software based kill cards to support the decision making and provide quick response during firefighting, damage control or NBC scenarios. Each software kill card shall include all relevant information about all or selected compartments on the ship.
- (f) Stability Software
- (i) The software shall provide real-time information of tank loading status, condition of variable loads and stability parameters of intact ship as well as for damage scenarios as per latest edition of Def Stan 02-900, Part 4, Issue 1 and indicate remedial measures in case of damage.
 - (ii) The stability software shall be provided through a standalone system placed in DCHQ and will be available at Fwd Section base/Alternate DCHQ through interface to BDCS. The software shall be interfaced with IPMS for BDCS functionalities with online feed from tank gauging. The software shall be able to perform following:-
 - (aa) The internal data base of the software shall include under mentioned main particulars of the Ship:-

- 1) Length Overall (LOA)
- 2) Length between Perpendicular (LBP)
- 3) Beam
- 4) Mean Draught (at full load)
- 5) Fwd Draught (at full load)
- 6) Aft Draught (at full load)
- 7) Ton per Centimeter (TPC)

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- 8) Movement to Change Trim (MCT)
- 9) Longitudinal Centre of Buoyancy (LCB)
- 10) Vertical Centre of Buoyancy (VCB)
- 11) Deep Displacement
- 12) Trim
- 13) List
- 14) GZ curves, Cross curves and Hydrostatic curves
- 15) Centre of Gravity from Keel (KG)
- 16) Vertical Centre of Buoyancy from Keel (KB)
- 17) Metacenter from Keel (KM)
- 18) Metacenter from Buoyancy (BM)
- 19) GM

(ab) Floodable volume for all W/T- sections / sub-sections shall be predefined in the system.

(ac) Reserve buoyancy of the ship shall be predefined in the software.

(ad) In case of a damage/flooding, following input shall be fed by Ship Staff:-

- 1) Flooded compartment name/ location (as necessary by software).
- 2) Percentage of compartment already flooded due to flooding.
- 3) Percentage of adjacent compartment flooded due to flooding.
- 4) The approx. dimensions of the damage.

(ae) Following outputs is desired by the software:-

- 1) Rate of water ingress.
- 2) Quantity of volume flooded.
- 3) Reserve buoyancy available.
- 4) Suggest counter flooding measures.
- 5) Produce stability parameter prior and post application of suggested counter flooding measures.

(af) The software shall be able to perform multiple iterations for various de flooding scenarios and provide following outputs:-

- 1) Reserve buoyancy available.
- 2) Comparison between stability parameter prior flooding and through suggested and post application of each de-flooding iteration.

(ag) At the end of the exercise, the software shall be able to set the new parameters as the initial parameters to be ready for further damage controls.



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(ah) On repair of the damage, there shall be a provision to auto restore the initial stability data.

(iii) Inputs from draft sensors should also be provided to Stability Software with live display of values of draft, list and trim on stability system BDCS and IPMS console.

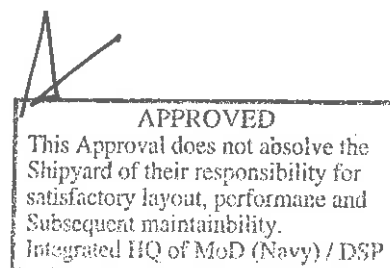
(iv) The software should calculate intact stability parameters considering the current loading condition with option of auto reading of tank levels and draft or through manual entry of variable loads by the user.

(v) Similarly, loading condition prior to damage should be used by the software to calculate the damage scenario. The user should also be able to update the damage/flooding scenario fed earlier.

2.11.4 CCTV System: IPMS shall be provided with a machinery CCTV system with adequate video storage capacity to record and store data for a minimum period of 30 days. The IPMS shall have remote control and monitoring of CCTV cameras fitted in all Machinery Compartments. CCTV cameras in machinery spaces will have provisions of PTZ and IR capability. This system will be independent of Ship's CCTV system (Ship's CCTV system is not in scope of this SOTR).

One (01) in no. each of indoor machinery CCTV camera of IP-44 type will be provided at the following locations:-

- (i) STP Compartment
- (ii) Auxiliary Machinery Compartment
- (iii) FWD Engine Room
- (iv) FWD Engine Room Mezzanine
- (v) AFT Engine Room
- (vi) AFT Engine Room Mezzanine
- (vii) PORT Shaft
- (viii) STBD Shaft
- (ix) Steering Compartment



2.11.5 Equipment Health Monitoring(EHM) Module, including Vibration Trend Monitoring:-

(a) A proven Equipment health monitoring functionality with data logging, trends, plotting, recording running hours, vibration

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monitoring, etc. shall be provided. The System shall record all warnings and alarms.

- (b) The EHM software shall be capable of data recording and trending in both online & offline (Manual input of data) mode. Software shall be capable of report generation based on both online and offline fed data.
- (c) The software shall display the vibration data of propulsion machinery using the vibration sensors. Vibration sensors shall be under the scope of supply of IPMS vendor. Type, Quantity & position of vibration sensors will be recommended by the propulsion machinery equipment manufacturer.

2.11.6 Artificial Intelligence/Machine learning enabled Decision Making Module:

The IPMS shall feature Artificial Intelligence/Machine Learning enabled decision making module for fault detection and diagnosis and maintenance scheduling. The algorithm used for enabling such a feature shall be of proven design and have implementation credentials in a process control application. The algorithm shall be able to detect faults early, enable accurate root cause identification, repeatability of results and identification of novel defects. This module shall be restricted to only Propulsion train. Software shall have provision for manual input of faults.

2.11.7 Onboard Training Simulator (OBTS): The OBTS shall allow any console, group of consoles to be placed in training mode. Consoles that are in training mode shall be precluded from displaying "real" data and from issuing commands. When in training mode, consoles are to remain active (though in the background) in the main data bus to ensure that at least one console is in control of the real data. Data communications for training shall not use the networks used for normal operational communication.

2.11.8 Engineers' Alarm System: Engineers' Alarm system as per ABS Rules for +ACCU Notation to be provided. Where alarms are not acknowledged at MCR in a pre-set period of time the system is to activate the engineers alarm audible in the following locations:

- (a) Engineer officer Cabin – 01 No.
- (b) Engineering office – 01 No.
- (c) Wardroom/ Officer's dining hall - 01 No.

2.11.9 Tank gauging system: Tank gauging sensors to be provided as per Annexure 2.

2.11.10 Draft Sensors: 04 nos of draft sensors are to be provided. Sensors to be supplied along with class approved flanged type isolating valves with junction boxes

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2.11.11 Bilge Switches :Bilge Switches to be provided as per Annexure 2

2.11.12 Portable Operating Unit (POU): One (01) in no. of POU along with three (03) in nos. of sockets (at EO Cabin, MCR Console and Alt DCHQ console) shall be supplied.

2.12 Electrical Requirements

2.12.1 Power Supply available onboard:

(a) 415 V AC, 50 Hz, 3 Phase, 3 wire with floating neutral.

(b) 230 V AC, 50 Hz, 1 Phase.

Notes:

In case of any special power requirements other than the standard voltages mentioned above, OEM has to ensure means of generating the same within his system from the available power and the system to be configured accordingly. The equipment shall be capable of operating in a steady state voltage of -10 to +6% and steady state frequency variation of $\pm 5\%$ respectively.

2.12.2 Cables: All Internal wiring of the equipment should be LSFH cables. All the system intra connected specialized cables to be supplied by OEM. Supplied length of cable should be adequate for proper installation onboard. Lengths of the cables shall be finalized post detailing.

2.12.3 Cable Glands: Cable glands for the incoming and outgoing cables of the equipment shall be supplied/installed along with equipment. The cable gland shall conform to specification NES 514 or DGS/EED/VI/1535/R6 or BS6121/ EN 62444-2013. The sizes of the Glands shall be discussed and agreed during Binding data correspondences.

2.12.4 Terminals: Bolted type/ WAGO type terminal and crimped socket of electrolytic copper are to be provided for all incoming and outgoing cables. Adequate spare terminal strip is to be provided for provision of additional control and indication facilities. Adequate space is to be provided inside the equipment for bending and termination of incoming and outgoing cables.

2.12.5 Connectorisation: Vendor will be responsible for the all work pertaining to connectorisation (only special cables) on-board ship. All items/ accessories/ tools/ consumables required for connectorisation and check wire will be in the scope of OEM.

2.12.6 Enclosure & Ingress Protection: The IPMS Consoles and RTUs shall be tested for Drip Proof Test as per JSS 55555 (Test 11).The ingress protection for balance equipment will meet class requirements.

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2.12.7 ESD Protection: The system design shall take into account adequate measures for Electro Static Discharge (ESD) control and protection at PCB/module/assembly and unit level. Each ESD sensitive part/assembly will be duly marked with a symbol/warning. The supplier will use ESD protective materials for handling, packaging storage and transport.

2.12.8 Earthing: All electrical devices and control panel shall be provided with external earth terminal of brass or stainless steel.

2.13 Noise and Vibration & Shock Standards

All Electrical and Electronic Equipment are to be designed and constructed to withstand the shock & vibration requirement as indicated in Para 2.15.1. Wherever required, necessary shock mounts / J straps shall be provided for Equipment/ units.

2.14 EMI/EMC

2.14.1 IPMS shall provide high tolerance EMI/EMC in accordance with MIL STD 461 E/F.

2.14.2 The equipment design shall consider electromagnetic interference (EMI) coming from the external sources, generated from within its own enclosure and degrading the performance of the equipment.

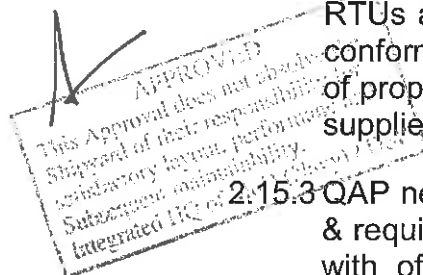
2.14.3 EMI shall be reduced by judicious selection of components and use of good engineering practices like grounding, bonding and shielding. Requirements of ground, bonding and shielding as per MIL-STD-1310H.

2.15 Quality Assurance Plan

2.15.1 All the electrical equipment, except for COTs equipment be tested for conformance to tests as per JSS 55555. COTS item of ruggedized marine type will be used where ever available. List of COTS item along with Type Approval certificate (where applicable) to be provided by IPMS supplier.

2.15.2 As far as possible, the consoles and RTUs already tested for conformance as per JSS 55555 (2012 Rev.3-Amendment 1 Jul 2014) and EMI/EMC in accordance with MIL STD 461 E/F are to be used. The RTUs and Consoles, if not already tested, are required to be tested for conformance as per aforementioned condition. OEM to submit the details of proposed JSS 55555 tests for discussion at TNC, in line with latest IN supplied IPMS systems.

2.15.3 QAP needs to be prepared by OEM in accordance with all IN standards & requirements. A draft QAP/IN approved QAP shall be submitted along with offer and which shall be forwarded to IN through shipyard for approval.



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2.15.4 QAP Tests shall be inspected by IN/ABS as per the approved QAP.

2.15.5 During equipment production the equipment shall be subjected to various stage inspections. Equipment supplier shall ensure high quality of production as per approved quality assurance plan. During equipment production, any deviation to the QAP/finalized specifications/standards shall be brought to the notice of Shipyard, along with valid reasons and recommended solution, without any compromise on quality, reliability and performance of the equipment.

2.16 Safety/Lifting Arrangements/Tally & Diagram Plates

2.16.1 Name/Instruction, Tallies & Diagram Plates:

- (a) Name plates, instruction plates, start/stop procedures, warnings, prohibitions, Tallies, diagram plates, etc. for all equipment shall be made of anodized aluminium alloy/SS304/Brass Plates. Size of tally plate and their letters shall conform to specification NES-723.

2.16.2 Safety

- (a) 415V, 230V danger tally shall be provided on the equipment at a prominent place where required.
- (b) Safety markings on main equipment and associated devices shall be provided.

2.16.3 Lifting arrangement:

- (a) Lifting arrangement should be suitably provided for the equipment as applicable, considering installation, removal and maintenance activity onboard.
- (b) Specialized lifting gear for the proper transportation of equipment (e.g. spreader beam, lifting beam etc.) is to be provided by the OEM as applicable.
- (c) Equipment weighing over 40 kg shall have lifting eyes to facilitate lifting.

2.17 Spares (OBS & B&D), Special Tools and Test Equipment, Accessories

2.17.1 OBS

- (a) On Board Spares (OBS) - 01 set per ship shall be provided.

- (b) An itemized list of special tools, OBS for two (02) years exploitation of the ship is to be furnished along with the quotation for the main equipment.

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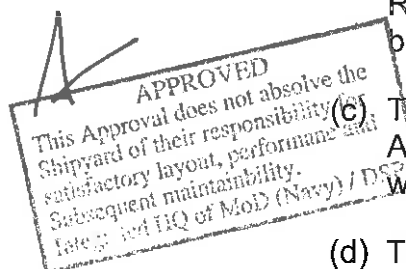
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- (c) The OBS list shall be provided in the ILMS format enclosed at Annexure 1. Separate offer for OBS shall be provided along with main offer.
- (d) The OBS and special tools and test equipment are to cater for all the onboard maintenance routines and possible repair requirements. The list of MRL-OBS shall be discussed and finalized at TNC.
- (e) The MRL-OBS has to be recommended based on the likely consumption rate of the spares and on the exploitation pattern of the equipment. In case the equipment has been built earlier/equipment is already in usage, the spare parts requirement for the associated equipment shall be based on statistical consumption pattern, rather than only being based on the MRLS. Bidder quoting lesser MRL-OBS in terms of range and depth as well as quantity will have to make good deficiency at their cost without any financial responsibility or liability to the Buyer within 60 days of intimation by the buyer to render equipment operational. Buyer would also have the option to amend the MRL-OBS proposed by the bidder during the Technical Negotiation of individual equipment to ensure its sufficiency, based on its past experience of exploitation of same/ similar equipment. The seller would either 'Buy Back' the spares rendered surplus or exchange them on cost to cost basis with the spares as required by the Buyer. The said spares would be purchased/ replaced by the Seller, based on the prices negotiated in the contract.

2.17.2 Base & Depot Spares

- (a) Base & Depot Spares/Comprehensive Part Lists - 01 set for the project shall be provided.
- (b) Base and depot spares recommendation is to cover maintenance/overhaul requirements for Five (05) years exploitation. Recommendation for insurance holding of long lead items is also to be indicated.



- (c) The B&D list shall be provided in the ILMS format enclosed at Annexure 1. Separate offer for B&D spares shall be provided along with main offer.
- (d) This list would contain price, description, Pattern no. and quantity fitted on each equipment in respect of various parts/ components.

2.18 Product Support

2.18.1 OEM is to provide product support in terms of maintenance, materials and spares for a Minimum period of 30 years excluding electronic equipment for which the minimum period would be 10 years. OEM is to provide product support for the said period at the owner's (IN)

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designated Naval base port. Even after the said mandatory period, OEM would be bound to give at least 2 years notice to the Buyer prior to closure of the said production line, to assess the requirement of life time buy of all spares before closure of the said production line.

2.18.2 RRC/ AMC. OEM to indicate willingness to enter into RRC/AMC with IN for the equipment along with technical offer.

2.18.3 Technical Assistance / Service

- (a) The OEM shall provide the necessary representative(s) to assist, as and when required, in carrying out inspection and supervise the work that is done on the equipment, during the various phases as receipt inspection of the items at store, Preparation for installation of equipment by shipyard, Monitoring of proper equipment preservation during storage, On-board erection and alignment, Setting to Work (including fitment of latest calibrated instrumentation), Harbour Trials, Assistance in trouble shooting, Customer Sea Trials, Post CST equipment Inspections, Assistance in operation during equipment guarantee period. Para 4.3 also refers.
- (b) Special tools and instrumentation (with valid calibration certificate) required for installation, commissioning testing/trials at yard premises are to be carried by OEM service engineer.

2.19 Training

2.19.1 The supplier shall conduct an operational and maintenance training course to the ship's crew/ maintainers for a period of 10 days for a crew of 08 at the shipyard premises.

2.19.2 Training shall be conducted in English.

2.19.3 Complete training package for on board exploitation, maintenance and for second level maintenance along with tools and test kit to be offered. All training material shall thereafter be handed over to Navy for future training requirements. The training schedule shall be prepared in consultation with WOT/Ship Staff/Shipyard well in advance. The training should include following aspects: -

Ser	Training Requirement	Topics to be covered	Team Composition
(i)	Equipment and System description	<ul style="list-style-type: none"> Description of all components of IPMS. Layout of the system. Material characteristics. 	SS+Yard

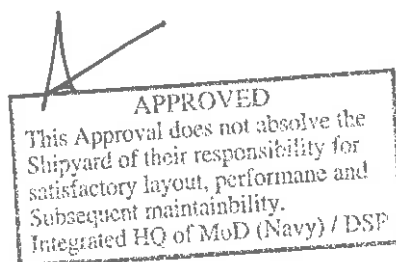
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<u>Ser</u>	<u>Training Requirement</u>	<u>Topics to be covered</u>	<u>Team Composition</u>
(ii)	Operating Philosophy and Parameters	<ul style="list-style-type: none"> • Different modes of operations. • Start/ stop procedure. • Parameter checks during operation. 	SS
(iii)	Emergencies	<ul style="list-style-type: none"> • Operation through HWP. • Troubleshooting 	SS
(iv)	Safety Instructions	<ul style="list-style-type: none"> • PPE requirement. • Safety precautions whilst operating the equipment. • General safety procedures for men and the equipment. 	SS+Yard
(v)	Onboard maintenance	<ul style="list-style-type: none"> • Repair/ replacement of control system • Use of special tools for maintenance. 	SS+Yard
(vi)	Repair Philosophy	<ul style="list-style-type: none"> • Repair / replacement of cables. 	SS+Yard
(vii)	Instrumentation	<ul style="list-style-type: none"> • Operating principle. • Replacement procedure. • Calibration. 	SS+Yard



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CHAPTER 3- SCOPE OF SUPPLY

3.1 Scope of Supply

An indicative table is placed below:-

Ser	Requirements	Qty/Ship	Remarks
(a)	MCR Consoles	01 Set	As Per Para 2.4.18 (a)
(b)	Large Screen display	01 no.	As Per Para 2.4.18 (a)
(c)	COTS Printers (at MCR & DCHQ)	01 Set	
(d)	Bridge Console items (carcass is in scope of IBS supplier)	01 Set	As Per Para 2.4.18 (b)
(e)	OPS Room Console	01 Set	As Per Para 2.4.18 (c)
(f)	BDCS Console for DCHQ & Alternate DCHQ	01 each	As Per Para 2.4.18 (d)
(g)	Bulkhead Consoles for Section Bases	02 nos.	As Per Para 2.4.18 (f)
(h)	Emergency EOT for Bridge, MCR & Emergency MPP posts, for both propulsion trains	01 Set	As Per Para 2.4.18 & 2.4.19
(i)	Portable Operating Unit (POU)	01 Set	As per Para 2.11.12
(j)	Splitter Units for Critical Signals	As per System Design	
(k)	RTUs	01 Set	As per Para 2.4 Qty of RTU will be finalized during the I/O List finalization.
(l)	Gateway for IBS, APMS, SDN	01 Set	
(m)	UPS	01 Set	As Per Para 2.3.2
(n)	Accessories (Network Switches, connectors, junction boxes, vibration mounts, shock Mounts, Fasteners etc.)	As per System Design	
(o)	Equipment Health Monitoring	01 Set	As Per Para 2.11.5

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Ser	Requirements	Qty/Ship	Remarks
	and Vibration Monitoring System		
(p)	AI/ML Decision Making Module	01 Set	As Per Para 2.11.6
(q)	Tank Level Sensors and accessories	01 Set	As per Para 2.11.9 and Annexure 2
(r)	Draft sensors	04 nos.	As per para 2.11.10
(s)	Bilge Sensors	01 Set	As per para 2.11.11 and Annexure 2
(t)	CCTV Cameras	01 Set	As per para 2.11.4
(u)	Connection Boxes for door and hatch sensors	01 Set	As per Para 2.6.9 (d)
(v)	On Board Training System	01 Set	As Per Para 2.11.7
(w)	Standalone System for Online Stability monitoring along with software/ license and accessories at DCHQ	01 no.	As Per Para 2.11.3
(x)	Engineers' Alarm System	01 Set	As Per Para 2.11.8
(y)	Hard wired panels/instrumentation	01 no.	As per Para 2.6 and 2.11.1
(z)	Reference System	01 Set (only for first vessel)	As Per Para 2.4.17
(aa)	Special Tools & test Equipment	As required	
(bb)	Technical Documentation	01 Set	As Per Para 1.5
(cc)	Training	01 Set	As Per Para 2.19
(dd)	Packing & Preservation	01 Set	As per Para 4.1
(ee)	Transportation & Insurance	01 Set	As per Para 4.1
(ff)	Warranty & Guarantee	01 Set	As per Para 1.4
(gg)	OBS	01 Set	As Per Para 2.17.1
(hh)	B&D Spares	01 Set	As Per Para 2.17.2
(ii)	Installation & Commissioning Spares	01 Set	As Per Para 4.4
(ii)	Service Support (Design/installation/STW/trials)	01 Set	As Per Para 4.3 and 2.18.3

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Note: Any item not explicitly mentioned above but required to ensure system completeness/class requirement shall be in OEM scope of supply. Complete list of items shall be submitted with the offer.

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CHAPTER 4 - MISCELLANEOUS

4.1 Preservation & Packaging/Transportation/ Special provisions for storage

- 4.1.1 The preservation and packaging of the equipment to ensure that there is no damage in transit and deterioration during the period when the item is in storage
- 4.1.2 Duration of validity of preservation to be indicated.
- 4.1.3 Methodology for receipt inspection without affecting preservation (for main equipment and loose supplied items) is to be indicated by the OEM including any requirement for re-preservation
- 4.1.4 The procedure for re preservation to be supplied by the firm.
- 4.1.5 Requirement of special provisions for storage and transportation to be indicated.
- 4.1.6 Any consumables required for preservation/ re-preservation beyond a stipulated time period to be clearly indicated by OEM.
- 4.1.7 The equipment packaging, waterproofing, containerization and preservation are to be done in accordance with MIL-STD-2073-E1 for direct vendor deliveries to shipyard, meant for installation onboard the vessel.

4.2 Inspection

Anticipated date of dispatch of equipment is to be intimated to yard at the time of placement of PO. 45 days firm notice to be given to IN for scheduled Pre Dispatch Inspection. Pre Dispatch Inspection (PDI) of equipment to be fitted on vessels would be at the discretion of the Shipyard/Indian Navy.

4.3 Requirement of Service Engineer for Design efforts, Installation, commissioning, HATs & SATs:

OEM shall clearly indicate the no. of days and no. of trips required by them for their equipment's / items installation, commissioning, HATs & SATs separately

4.4 Installation and Commissioning Spares

- 4.4.1 The supplier's service engineer shall carry one set of installation and commissioning spares during STW / HAT (wherever required).

4.4.2 Other Requirements

(a) Equipment shall be suitable for marine application.

(b) Details which are not mentioned in this specification, but essential for this Equipment to be furnished in accordance with maker's practice.

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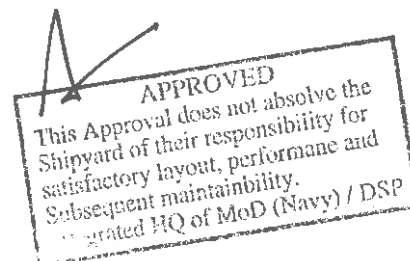
Also items required by rule and regulatory bodies referred in general requirements, shall be furnished and/or satisfied by maker.

- (c) Asbestos shall not be used for all the parts of equipment and heat Insulation.

4.5 Compliance Matrix

4.5.1 The offer should contain a comparative statement of the requirements vis-à-vis specifications of the respective items offered. In case the items offered are not fully conforming to the details given in the specifications, the deviations are to be specifically spelt out with valid clarifications. No deviation shall be granted after placement of order.

4.5.2 A compliance table in the format placed at Annexure 3 to be duly filled and shared along with the technical offer.



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ANNEXURE 1

ILMS FORMAT

ILMS FORMAT - DETAILS OF ITEMS FOR INCATING

Item Code (Max 24 Characters)	Item Description (Max 60 Characters)	OEM Equipment Code (Max 24 Characters)	Equipment Description (Max 60 Characters)	DENOMINATION (No./Set/Kg/Ltr)	CRP Category (Consumable, Permanent)	VED Category (Vital (under 10%), Essential (under 20%), Disposable (80%))	EASK Type (Equipment, Assembly, Sub-assembly & KIT)	EASK BOOK REPRP/L DRAWING REF number of P/L & details of item)	QUANTITY CONSTITUENT (Numbers in each equipment applicable for assembly & below)	QUANTITY OBS (As per Range & Scale)	QUANTITY B&D (As per Range & Scale)	Price (In Currency)	Price reference (with copy)
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Subsequent maintainability.
Integrated HQ of Mod (Navy) / DSP

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ANNEXURE 2

TANK SENSORS AND BILGE SWITCHES

The Quantities of tank level transmitters, switches and Bilge sensors are tentative and may change due to changes in GA/ Tank Plan.

TANK SENSOR-LEVEL TRANSMITTERS

<u>S.no</u>	<u>Tank</u>	<u>Qty (no.)</u>
1.	FO TANK 1S	01
2.	FO TANK 2P	01
3.	FO TANK 3P	01
4.	FO TANK 4S	01
5.	FO TANK 5P	01
6.	FO TANK 6S	01
7.	FO SERVICE TANK 1P	01
8.	FO SERVICE TANK 2S	01
9.	ME FO RU TANK 1P	01
10.	ME FO RU TANK 2S	01
11.	DG RU TANK 1	01
12.	DG RU TANK 2	01
13.	DG RU TANK 3	01
14.	DG RU TANK 4	01
15.	ME & DG LO TANK 1P	01
16.	GB LO TANK 1S	01
17.	AVCAT FO TANK_C	01
18.	AVCAT SERVICE TANK_S	01
19.	AVCAT DRAIN TANK_S	01
20.	FW TANK 1P	01

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<u>S.no</u>	<u>Tank</u>	<u>Qty (no.)</u>
21.	FW TANK 2S	01
22.	BILGE HOLDING TANK-P	01
23.	SLUDGE TANK-1S	01
24.	SLUDGE TANK-2S	01
25.	TRIM CORRECTION TK-1C	01
26.	TRIM CORRECTION TK-2C	01
27.	TRIM CORRECTION TK-3P	01
28.	TRIM CORRECTION TK-4S	01

TANK SENSOR-LEVEL SWITCHES

<u>S.no</u>	<u>Tank</u>	<u>Qty(nos.)</u>
1.	AVCAT SERVICE TANK_S	01 in no. high level
2.	BILGE HOLDING TANK-P	01 in no. high level 01 in no. low level
3.	SLUDGE TANK-1S	01 in no. high level 01 in no. low level
4.	SLUDGE TANK-2S	01 in no. high level 01 in no. low level
5.	COOL AND COLD ROOM DRAIN COLLECTING TANK	01 in no. high level

BILGE SWITCHES

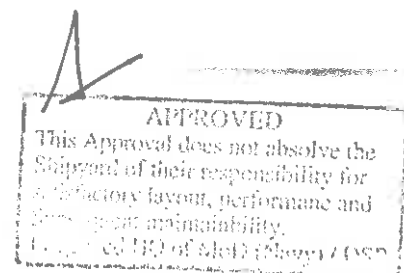
<u>S.no</u>	<u>Location</u>	<u>Qty (nos.)</u>
1.	STEERING GEAR COMPARTMENT	01
2.	STERN THRUSTER	
3.	AVCAT COMPARTMENT	
4.	AFT ENGINE ROOM(AFT AND FWD)	02

01
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<u>S.no</u>	<u>Location</u>	<u>Qty (nos.)</u>
5.	FWD ENGINE ROOM(AFT AND FWD)	02
6.	AUX MACHINERY COMPARTMENT	01
7.	STP COMPARTMENT	01
8.	BOW THRUSTER COMPARTMENT	01
9.	SONAR COMPARTMENT	01
10.	SHAFT TUNNEL (PORT)	01
11.	SHAFT TUNNEL (STBD)	01

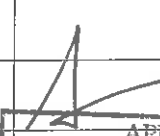


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ANNEXURE 3

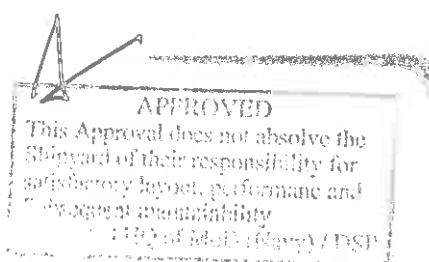
COMPLIANCE MATRIX

Para Number	Headings & Sub Headings	Compliance
	CHAPTER 1 - GENERAL	
1.1	Introduction	
1.2	Principal Particulars of the vessel	
1.3	Design, Environmental and Seaway Conditions	
1.4	Guarantee & Warranty	
1.5	Technical Documentation	
1.6	Testing / Trials and Inspection	
1.7	Rules, Regulations, References & Standards applicable for the Vessel	
	CHAPTER – TECHNICAL REQUIREMENTS	
2.1	Function & Performance	
2.2	Applicable standards for the equipment/System	
2.3	Redundancy, Back Up Supply, Data Logging Capacity and Growth Margin	
2.4	Design, Construction and configuration, mounting Arrangements	
2.5	Modes of Operation	
2.6	Interface definition and protocol	
2.7	Space, Weight and Size	 APPROVED This Approval does not absolve the Shipyard of their responsibility for satisfactory layout, performance and subsequent maintainability. Head HQ of MoD (Navy) / DSP
2.8	Physical and material characteristics, surface coating, painting	
2.9	Maintainability, Availability, Reliability	
2.10	Operation Cycle, Operational Life	

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Para Number	Headings & Sub Headings	Compliance
2.11	Control System and Monitoring	
2.12	Electrical Requirements	
2.13	Noise and Vibration & Shock Standards	
2.14	EMI/EMC	
2.15	Quality Assurance Plan	
2.16	Safety/Lifting Arrangements/Tally & Diagram Plates	
2.17	Spares (OBS & B&D), Special Tools and Test Equipment, Accessories	
2.18	Product Support	
2.19	Training	
	CHAPTER 3 – SCOPE OF SUPPLY	
3.1	Scope of supply	
	CHAPTER 4 – MISCELLANEOUS	
4.1	Preservation & Packaging/Transportation/ Special provisions for storage	
4.2	Inspection	
4.3	Requirement of Service Engineer for Design efforts, Installation, commissioning, HATs & SATs:	
4.4	Installation and Commissioning Spares	
4.5	Compliance Matrix	



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