

LIST OF TECHNOLOGIES & SYSTEMS

1. **HMES (HULL, MECHANICAL, & ELECTRICAL SYSTEMS):**

a. **Materials.** Presently PN is using ships of European, American and Chinese origin utilising different types of steels for ship's construction. These include Admiralty 'B' grade steel (BS 4360 43 A /D), 907A high tensile low alloy steel, DH 36 and grade A steel. Yield strength of these steel ranges from 235 to 390 MPa. Super structures of the vessels are made up of Marine grade Aluminium 5083. In addition to metallic materials, composite materials like GRP, FRP etc are also being used in the hull of the vessels. Rubberized inflatable hulls (Zulu Boats) are also being used by PN.

b. **Electrodes.** For welding of ferrous and non-ferrous metals, wide variety of welding consumables are used in PN including E-6013, E-7018, E-8018C-3, E-309-15 and E-309-16 etc.

c. **Water and Gas Tight Doors and Windows.** A large number of water and gas tight doors / hatches, windows and scuttles of varying sizes are used onboard PN platforms. These are tested by utilising 2 different methods i.e. vacuum testing or pressure testing at low pressure (ranging 2-5 PSI).

d. **Fixtures and Fasteners.** A variety of fixtures and fasteners (nuts, bolts, rivets etc) of various sizes and material specifications are being used onboard PN platforms. Material generally includes 316L, SS 304, MS and non ferrous alloys.

e. **Marine Ropes.** Marine ropes of different construction, types and sizes are used onboard PN vessels for berthing, lifting and hoisting purposes etc. These include steel wire rope, polyamide, polyester and poly propylene etc. Construction of these ropes ranges from 6x12 to 6x36. Sizes of the wire / strand ranges from 3mm to 28mm.

f. **Fire Retardant Cloth/Upholstery.** Due potential fire hazard onboard naval platforms, a variety of fire retardant materials are being used onboard. Fire retardant cloth is mainly used for fire fighting suits (suits, gloves, hoods etc), fire / smoke curtains and fire blankets etc.

g. **Paints and Coatings.** A large variety of paints / coatings are being used for protection of ship's structure from harsh Marine environment. These include oil / epoxy based, anti fouling, fire retardant and anti-skid paints etc. In addition, different types of coatings are also being used onboard PN vessels including Parco-plastic, abrasion/heat resistant linings and electro plating etc.

h. **Cables.** A variety of cables are being used onboard for power and data transmission. Power transmission cables onboard ships are generally marine grade halogen free type. However, various other types of the cables and winding wires of varying diameter and amperage are also being used. Data cables include co-axial, fibre optic and RF etc.

j. **Switchboards, Distribution Switch Gear.** PN is using vast variety of switch gear in various switchboards of ships, S/Ms, and shore units. These gears comprise of VCBs, MCCBs, Control Panels, Starters and Change over switches etc; mainly ranging from 11KV to 115V AC and 6V to 50V DC.

k. **Cathodic Protection System.** PN is utilising 2 x broad types of Cathodic Protection systems. Details of the same are as follows:

(1) **Usage of Electrode (Impressed Current Cathodic Protection) System.** This is an old system in which Electrode produces a specific amount of current that ionizes the body of ship / vessel and protects it from corrosion. The amount of current produced may vary depending upon the hull of ship. Nominal values of current range from 200 mV to 900 mV. These electrodes require corrective maintenance only.

(2) **Sacrificial Anodes.** As the name indicates, this system uses anodes that dissolve with the passage of time. They react with the chemicals in water and sacrifice themselves to protect the hull of ship. This system requires docking after specific time; however, PN has modified these anodes to replace these in situ through divers.

l. **Valves.** Various type and sizes of valves are used in PN. These belong to various types of systems e.g. Fresh Water, Sea Water, Fuel, Lubricants, and Steam etc. List of various types and sizes of valves used onboard PN vessels is tabulated below:

S.No	Type of Valves	Size Range (inches)
1.	<u>Gate Valve</u>	<u>2 to 12</u>
2.	<u>Globe Valve</u>	<u>2 to 12</u>
3.	<u>Butterfly Valve</u>	<u>2 to 12</u>
4.	<u>Cock/Plug Valve</u>	<u>1 to 6</u>
5.	<u>Ball Valve</u>	<u>½ to 4</u>
6.	<u>Diaphragm Valve</u>	<u>½ to 6</u>
7.	<u>Safety/ Relief Valve</u>	<u>½ to 5</u>
8.	<u>Check/ Non Return Valve</u>	<u>1 to 6</u>
9.	<u>Storm Valve</u>	<u>2 to 4</u>
10.	<u>Reducers</u>	<u>1 to 6</u>
11.	<u>Teleflex System Valve</u>	-
12.	<u>Thermostatic Regulating Valve (TRV)</u>	-

m. **Piping.** Pipes of various sizes, specifications/dimensions and material are being utilized in PN. The diameter of these pipes varies from 0.5 inch to 36 inches. Whereas, material of these Pipes include Mild Steel, Galvanized Iron (GI), Cupronickel (CuNi 70/30 & 90/10), Brass and Al Bronze etc.

n. **Heat Exchangers.** A large number/variety of Heat Exchangers (HX) are being used onboard PN platforms. These HX mainly use sea water as heat dissipating media. Shell & Tube, Plate and Co-axial (Tube & Tube) are the main types of HX , whereas material of tube / plate include Cupronickel 70/30 & 90/10, Titanium, Al Bronze and simple copper etc. Material of the shell is generally SS, high quality MS or non ferrous based alloys suitable for harsh marine environment.

p. **Mounts.** In order to obviate chances of noise transmission to ship's hull, different types of mounts are used onboard PN vessels. These include resilient mounts, spring mounts, ring mounts, vibration dampers and raft mounts etc in various configuration / shapes e.g. K type, L type and M types etc.

2. **AUXILIARY SYSTEMS:**

a. **System and Machinery Controls.** Mainly 4 different types of Machinery control systems are being used onboard PN ships / vessels. Details of the same are as follows:

(1) **RLC (Relay Logic Control).** This is the oldest control system being used involving relay logic. However, same is being upgraded on case to case basis.

(2) **ELC (Electronic Logic Control).** This system involves a number of nonprogrammable PCBs. Same can be considered for upgradation on case to case basis.

(3) **Microprocessor Based System.** This system involves programmable PCBs. It is easy to handle, presence of software and COTS components makes troubleshooting easier.

(4) **PLC (Programmable Logic Control).** It is one of the most advanced systems being used in PN. It is considerably compact sized as compared to earlier described systems. Same PLC can be used for different systems with amendment in program. Option to develop a standardized PLC based control system for its machinery control can be considered.

b. **Converters / Transformers.** Various types of AC to DC and DC to AC converters are used onboard different vessels. These generally range from 440 V AC to 24, 28, 50 V DC. Similarly, a number of step up & step down transformers are being used by PN ranging from 440 V to 220 and 115 Volts. In

addition, Motor Generators ranging from 50/60 Hz to 400 Hz of varying capacities are also being utilized.

c. **Motors.** A variety of AC and DC motors are being used. In AC motors, mainly induction motors are used which range from ½ HP to 75 HP of 440 V 50 / 60 Hz. Some squirrel cage motors are also being used. These motors drive various pumps, compressors and capstans etc.

d. **Non Magnetic Motors.** Ships are fitted with non-magnetic 88 KW, 440 V motors with variable frequency (5-17 Hz). It is essential that these should have non-magnetic characteristics.

e. **Auxiliary Power Units (APU).** Auxiliary Power Motors are used for propelling the vessels in case of emergencies (bring home device). The power rating of the unit is 325 HP with 440 Volts AC, 60 Hz; developing a thrust of approx over 13000 lbs. The starting current of the unit is 3400 Amps with 540 Amps running current.

f. **Power Generation (Generators).** Various kinds/types of generators are being used in PN inventory ranging from 1 MW to 50 KW producing 11KV-220V in 50 Hz and 60 Hz range. These vary mainly from brushless generators to regular brushed generators.

g. **Pumps.** A large variety of positive displacement and continue flow pumps of various types like centrifugal, close / open impeller, axial flow, reciprocating, gear / lube, rotating plunger and screw type pumps etc are being used. Flow rate of these pumps range from 0.1 GPM to 550 GPM with pressure ranging from 10 PSI to 800 PSI utilizing sea water, fresh / feed water, fuel and lube oil as pumping media.

h. **RO Plants.** RO plants are being used for fulfilling fresh and feed water requirements of various sea going and shore units. Onboard plants range up-to 7000 GPD with raw water intake designed for 48000 TDS. On shore requirement varies from 250 GPD to 250,000 GPD with intake designed for both sub soil and sea water.

j. **Air Compressors.** In order to fulfil requirement of compressed air for various purposes, a large range of compressors is being used. These compressors mainly include reciprocating, centrifugal and screw type ranging from 120 PSI to 4000 PSI. In addition, compressed air is also being used for breathing purposes fulfilling the required standard for human consumption.

k. **HVAC Systems.** A vast variety of HVAC systems for both sea going platforms as well as on shore units are being used. These plants comprise of hermetic, semi hermetic and classical reciprocating compressors with direct and in-direct expansion utilizing screw, scroll and seal rotary compressors etc. The plants range from 1.5 tons to over 200 tons capacity of varying operating principles i.e. absorption cycle, compression cycle etc. However, keeping in view

the changing trends in local market, it is intended to replace the existing plants with Variable Refrigerant Flow / Volume (VRF/V) plants.

I. **Batteries.** A large number of batteries for various purposes are being used. Apart from classical batteries for vehicles, UPS and DC voltage back up, batteries are also used for propulsion system onboard submarines. These propulsion batteries comprise 320 Q type cells divided into two groups of 160 cells each and installed in two separate compartments. It has total life equal to charge/discharge of 1.8 Million AH or 5 years whichever is earlier. The “lead-acid” electro-chemical group consists of oval tubular positive plates and flat negative plates. The cell is specially designed to ensure the best possible use of power for slow and rapid discharging and a low release of hydrogen in both open-circuit and floating configuration. General technical description of the cells is as follows:

(1)	Overall height:	1 140 + 0- 6 mm
(2)	Height under the cover:	1 066 + 2 mm
(3)	Width:	360 + 1 mm
(4)	Length:	450 + 1 mm
(5)	Weight:	528 Kg

3. **PROPULSION SYSTEMS:**

a. **Classical Steam, Diesel & Gas Turbine Propulsion.** A wide variety of propulsion systems ranging from classical steam ships to modern diesel and Gas Turbine (GT) driven ships utilizing fixed / controllable pitch propellers, Jet thrusters etc for propelling the vessel are being used. The power rating of the vessels is ranging from 500 HP to 18,000 HP.

b. **Full Electric Propulsion/Integrated Electric Propulsion.** In order to stay abreast with modern propulsion trends, it is being considered to acquire / operate full / integrated electric propulsion. Instead of a prime mover directly driving the propeller, propulsion will be through electric motors driven by a diesel or GT based prime mover.

c. **Drives.** Presently a variety of drives configuration are being used for propulsion. These include conventional straight drive utilizing shaft glands, bulkhead bearings, A / P brackets bearings and ‘Z’ drive. In addition, Marine jet Propulsion (MJP) and surface drive are also being used. Moreover, hovercraft utilizing air as a propulsion media instead of sea water are also in use.

4. **COMBAT & ELECTRONIC SYSTEM:**

a. **Sensors – Above & Underwater Sensors (Nav Radars, Echo Sounder, Speed Log, Wind Sensors/ Anemometer, Temperature, Humidity).** Above water and underwater sensors including navigational aids are considered paramount requirements for safe navigation/ other critical information at sea/ congested waters. Above water sensors are required to provide all information above the sea surface and include Navigational/ Surveillance Radars, wind speed & direction sensors including temperature and humidity measuring sensors. Underwater sensors are used to provide all critical information related to

depth, speed, underwater surveillance and target information. These sensors include Echo Sounders, speed logs and sonars etc. All information regarding above and underwater sensors is also utilized in Combat Management Systems and firing of critical weapons.

b. **Communication Systems (HF, VHF, UHF, Software Defined Radios (SDRs), SATCOM).**

Communication Systems are considered as backbone in all kinds of warfare especially in Maritime domain. Naval ships while performing operations at sea critically require effective communication systems for real time situational awareness, coordination, updates, tasking and feedback purposes. In order to ensure reliable and effective communication at sea, various kinds of communication systems as per requirement/ role are provided i.e. HF, VHF, UHF, SDRs and SATCOM etc. Moreover, naval ships operate worldwide and also coordinate with air and sub-surface platforms: hence, require all kinds of communication systems.

c. **IR Systems.** Thermal-infrared imaging is used extensively for military and civilian purposes. Military applications include target acquisition, surveillance, night vision, homing, and tracking. Popular IR systems include FLIR (Forward Looking Infrared Radiometer) and IRST (Infra-Red Search & Track) systems. The sensors installed in FLIR cameras use detection of infrared radiation, emitted from a heat source. An IRST system detects and tracks objects which give off infrared radiation such as jet aircraft and helicopters.

d. **Optical Systems.** Modern naval forces are expected to operate in a wide range of operational conditions and against an extensive range of potential threats. The threats above the surface can vary from large ships to small rubber boats and canoes, airborne threats as well as land-based forces in littoral operations. In a number of these scenarios, radar tracking must be supplemented by optical tracking. In order to complement radar sensing applications, an optical tracker provides additional functions such as target detection, target identification and intent detection at the visual level. A tracker for the maritime environment is an optical system that performs the automatic tracking of an above water target. Local industry may consider development of such system.

e. **Training Systems.** Due technological advancement, contemporary techniques / methods are used and regularly updated to train the HR. In PN, training systems are used for conducting various courses/ modules to personnel during their training and while they are deployed on various specified duties. PN is in need to improve domain expertise and targeted training aspects. To achieve this, active participation of local industries is required to propose new ways/means for training PN personnel both at training establishments and onboard ships.

f. **Computer Based Training (CBT).** Computer Based Training (CBT) system is used for providing training in a programmed way through computer. It eases the instructors to conduct the training sessions in very smooth and organized manners. CBTs are used for training of officers and personnel in related fields. It is considered as one the most effective tool/ technique to give quality training. The trainees practically see the working and operations of critical systems and associated hazards/ results. Hence, requirement exists to develop CBTs of various systems being acquired utilizing contemporary softwares/ tools.

g. **Simulators.** The simulators are generally replica of original systems and can be effectively utilized while saving life of original systems. Simulators are very useful for safe and quick training of various complex/ hybrid systems. By using relevant simulators, trainees get a chance to practically learn and freely operate the systems. They can simulate scenarios in various operating conditions including practical failure drills/ hazards. Simulators are a continuation requirement and local industry can play its role.

5. **INFORMATION / COMPUTER SYSTEMS:**

a. **Computer Hardware:** A variety of Computer Hardware is used in PN ranging from ordinary PC / Laptops to Servers, Storage Area Network (SANs) etc.

b. **Software:** Various commercial software like Windows, Linux, MS Office, Antivirus and other software are being used. Moreover, customized software including Inventory Management Systems, HR Management Systems and Office Automation Systems are also being used and remain a continuous requirement.

c. **Networking Equipment:** A large variety of networking equipment is used for Data Communication / transmission ranging from different types of Routers, switches and other renowned Networking equipment etc. In addition, Video Tele Conferencing (VTC) is also is being widely used.

d. **Information Security Devices:** Firewalls, encryptors and other info security devices are being used for implementation of Information Security Policies.

6. **FIRE FIGHTING, SAFETY AND SECURITY:**

a. **Fire Fighting Equipment.** Due potential fire hazard onboard naval vessels in particular and other shore units in general, a large variety of fire fighting equipment is being used in PN. Details of some of the common equipment are as follows:

S.NO	ITEM	DESCRIPTION/ SPECIFICATIONS
(1)	AFFF FOAM	AFFF liquid is used onboard ships and shore

	(20 Ltr Drums)	units for extinguishing liquid fire. Foam concentration 6% is required for onboard usage; whereas, 3% is required for the shore establishments.
(2)	Fire Fighting Suits and Gloves	These suits are made of fire retardant material and used by teams onboard ship for fighting the fire. They provide protection against fire and heat.
(3)	Anti Flash Hood	These hoods are being used to safeguard face against heat and flash. These should be Flame proof proban treated in white colour.
(4)	Gloves(Fire Fighter)	They are made of Leather with NOMEX lining and are used for fire fighting.
(5)	Rubber Boots	Different sizes of boots made up of synthetic rubber material are used for countering fire & flooding incidents.
(6)	Cement Rapid Hardening	Rapid hardening cement is used onboard ship to patch up holes/ cracks in under water hull.
(7)	Smoke Curtains	These curtains are made up of Fabric flame retardant, 1.2 m wide and 60 m long. These are used in combination of Flame Retardant luminous sheeting, roll 150 mm wide and 45 m long.
(8)	Fire Blanket	Fire blankets are made up of Silica fabric, 1.6 mm thick 910 mm wide, 10 m lengths and are used for protection against Class F fire (in deep fat fryers).
(9)	Soft Wood Planks, Wedges and Plugs	A large number of Softwood planks, Wedges and Plugs are used for damage control and leak stopping / shoring of varying sizes and shapes (e.g. Square, rectangular, circular etc).
(10)	Fire Extinguishers	Different types of fire extinguishers are used in PN including: (a) 2 Kg CO ₂ Fire Extinguisher. (b) 9 Ltr Stored Pressure Extinguisher (AFFF). (c) Stored Pressure Extinguisher (Dry Powder) (SPE (DP)). (d) Marinised 2 kg Dry Powder Extinguisher. (e) 6 Ltr Wet Chemical Extinguisher
(11)	Fire Hydrants	These are fitted to the fire-main system to provide water for fire fighting. Each hydrant consists of a screw down or single-action lever operated control valve controlling one

		or two outlets which should be blanked by caps when not in use.
(12)	Fire Hoses	Impermeable fire hoses are used for fire fighting which vary in length from 2 to 18 m. These are used in 2 x different sizes i.e. 50 mm in diameter for general use and 70 mm diameter for use with FB10X foam branch pipes and fixed inline inductors on flight decks and in hangar.
(13)	Fire Nozzles	Two types of hand-held nozzles are being used. These are Fire-fighter Nozzle and Water wall Nozzle. Turning of fire-fighter nozzle to one eighth of a turn provides a 2 m flat disc for personal protection. A further turn of one eighth of a turn to the right produces a 60° ragged spray, which is used for fighting fires. The output (flow rate) from a fire-fighter nozzle ranges from 10 – 17 m ³ /hr at 100 PSI. Whereas, Water wall nozzles are used to provide protection to fire-fighters. Their output ranges from 15.5 to 44.3 m ³ /hr at 100 PSI.
(14)	Extended Duration Breathing Apparatus (EDBA)	EDBA is a positive pressure, first-breath activated, lightweight, low maintenance set, fitted with a 9 Ltr air cylinder (free air capacity 2430 Ltrs) capable of being charged to 300 bar. The set comprises a one-size facemask with a net head harness, an ergonomically designed back plate with a comfortable flame retardant harness, a lightweight composite air cylinder, a high pressure reducing valve, a warning whistle and a pressure gauge. The facemask assembly is fitted with an oro-nasal mask, an exhalation valve incorporating a speech diaphragm, and an automatic first-breath operated positive pressure demand valve. The demand valve is designed to be re-set by pressing the black rubber re-set button (on the demand valve).
(15)	Emergency Escape Breathing Device (EEBD)	The EEBD is a one-shot, short duration re-breathing set that provides respiratory protection for personnel escaping from a toxic or smoke-filled atmosphere. It is in orange coloured plastic case and comprises of mouthpiece, nose clip, neck strap, an oxygen cylinder, a breathing bag and a face shield.

- b. **Armoured Plating Vehicles / Armoured Plated Vehicles**. A large number of armoured plated vehicles are being used in PN. Moreover, a large number of vehicles are also being converted / protected with armour plating.
- c. **Personal Protection Equipment (PPE)**. PPE includes Bullet Proof Helmets, Bullet Proof Jackets, and Bullet Proof Vests etc. These are being used in various sizes.
- d. **Bulk and Trace Explosive Detectors**. These are being used based on different detection technologies available in the market.
- e. **Luggage / Personnel Scanning Systems**. Different types of luggage / personnel scanning systems are used commensurating with latest trends of industry.
- f. **Binoculars**. Various types of binoculars are used in PN. These range from normal day use binocular to Night Vision Goggles and Thermal Night Vision (NVDs / NVGs) etc.
- g. **Communication Jammers**. Various types of jamming equipment is used in PN covering UHF/VHF, 2G, 3G, 4G communication for mobiles and other wireless communication equipments.
- h. **Personnel / Vehicle Access Control System**. Various types of personnel and vehicle access control systems are used. These systems also include biometric system for better security.
- j. **Intrusion Detection System**. Various intrusion detection systems are used based on e-fence, optical or movement detection sensors.
- k. **CCTV Systems**. Different types of CCTV systems are used for indoor / outdoor, 24/7 surveillance / monitoring. Some of these systems are equipped with motion sensors.