15 YEAR INDIGENISATION PLAN

(2008-2022)

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INTEGRATED HEADQUARTERS
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CHAPTER 1- INTRODUCTION

1.1. Over the last two decades or so, the world has witnessed a revolution of technology like never before. Not only have we as a nation embraced the winds of change but also have often pioneered path breaking technological advancement and scientific discovery. The world has watched and acknowledged this progress made by India. Thus it is indeed imperative that the Indian Navy rides the waves of our national initiative and endeavour towards self-sufficiency and places Indigenisation on top of its priority list. Indian Navy's quest for evolution as a major global force demands self-sufficiency through a reliable, sustained and revitalised Indigenisation programme. This is in inconsonance with our national vision of sustained growth fuelled by technological and industrial development.

1.2. Development in the field of Naval systems is inherently technology intensive and requires substantial investment of time, money and resources. Advancements in technology are no longer the preserve of defence and it is often the civil sector and the commercial concerns which drive technology today. Industry including the private sector can therefore play a vital role in meeting sophisticated needs of the armed forces through cost-effective utilisation of its know-how and existing infrastructure.

1.3. Technology substitution in the process of indigenisation of imported equipment also boosts the R&D effort in the country. It should be recognised as the Key Result Area by the industry and policy planners. Premier academic institutions should be encouraged to take up projects for technology substitution and the industry should sponsor these projects. Following should be taken into account while selecting equipment for technology substitution: -

(a) The technology should be contemporary.

(b) The developed technology should preferably have a compatible market interface to guarantee product support.

(c) It should be up gradable with changing time and demand.

1.4. The Navy as a customer, the designers of equipment and systems and the industry as a supplier need to have a clear understanding of the requirements and the plan for induction and indigenisation. Keeping this in focus, the ‘15 Year Indigenisation Plan’ was first prepared and promulgated in 2003, in keeping with the induction plan of new platforms. This plan was to be reviewed after every five years. The 15 Year Indigenisation Plan has been revised based on requirements up to 2022 and formulated under the following major heads: -

(a) Marine Engineering.

(b) Electrical Engineering

(c) Weapons and Sensors

(d) Submarine Equipment and Systems

(e) Project – 75 Equipment and Systems

1.5. Present status of various indigenisation activities has been included for maintaining continuity and to avoid duplication of efforts. Also, to focus efforts of development agencies a forecast requirement of equipment and systems has also been worked out and placed at Appendices ‘A’ to ‘E’.

CHAPTER 2 - MARINE ENGINEERING

2.1. Major equipment and systems such as propulsion plants, prime-movers for power generation, air conditioning and refrigeration plants employed on board ships are specifically designed for marine application or are derived (marinised) from successful commercial models. Some commercial off the shelf (COTS) equipment is also existing in the IN inventory.

2.2. Indigenous development of Engineering equipment and systems is being undertaken through a combination of ab-initio development, adopting off the shelf designs and the process of re-engineering.

2.3. Warship equipment are designed to inherently meet the following requirements:-

(a) Assured performance in the presence of six degrees of ship motion, significant of which are roll and pitch.

(b) Ability to withstand shock loads.

(c) Appropriate material and metallurgical composition to withstand corrosion and erosion.

(d) Assured performance when submerged /partially submerged.

(e) Wide temperature variation in machinery spaces.

(f) Attenuation of airborne and structure borne noise by appropriate vibration mountings.

(g) Modularity in design to assure high level of maintainability in heavily congested machinery spaces.

(h) Reliable operation in the presence of high levels of humidity.

(j) Utilisation of seawater for cooling systems / heat exchangers.

2.4. For the purpose of indigenisation, engineering equipment can be broadly classified into following categories: -

(a) Main Propulsion Equipment.

(b) Prime Movers for Power Generation Equipment.

(c) Auxiliary Equipment.

(d) Machinery Control Systems/Equipment.

(e) Miscellaneous Equipment

Main propulsion equipment

2.5. The main propulsion plant of a warship should have the following essential characteristics: -

(a) Capability of high maximum speed as well as low speeds for loitering and patrolling.

(b) Good endurance in order to be able to stay on patrol for a long period of time.

(c) High availability and maintainability

(f) Reversing capability

(g) High power to weight ratio

(h) Compact and modular construction

2.6. Indian Navy currently employs the three conventional propulsion modes i.e. steam plants, diesel engines and gas turbines. Sufficient developments have been made in respect to steam propulsion plants and small diesel engines. Indigenously manufactured steam turbines of BHEL, main propulsion diesels of Kirloskar Oil Engines Limited, are already in use onboard ships. However there exists a perceptible gap in high power diesel engines and gas turbines.

2.7. **Gas turbines.** Gas turbines, in the range of 11-15 MW and 20-25 MW are required for fitment on board future ships as main propulsion units. Presently all gas turbines, fitted in Naval ships are of foreign origin. There is an urgent need to develop indigenous gas turbines. Indigenisation initiatives taken in this regard include the following

(a) General Electric's LM 2500 gas turbine is being inducted on the basis of its licensed manufacture in India with progressive increase in indigenisation. The first set of two gas turbines have been assembled and tested by HAL, Bangalore.

(b) Development of a fully indigenous Kaveri Marine Gas Turbine (marine derivative of LCA gas turbine) is in advanced stages at GTRE, Bangalore.

2.8. **Diesel engines.** Diesel engines in the range of 1-7 MW are used as main propulsion units. The primary requirement is for low noise levels, high availability and reliability. Though there exist a great degree of self-reliance in lower power range, the high power diesel engines to Naval specifications are largely imported or assembled in India. Indigenous manufacture / development of high power diesel engines to naval specifications will greatly reduce our dependence on imports. In addition to above the following specific requirements also exist:-

(a) Motor Boat Engines. The Survey motor Boats (SMB) and the Rigid Inflatable Boats (RIBs) are powered by diesel engines in the power range of 100-250 HP. These engines are to be of lightweight and rugged in design and having a high Mean Time between Overhaul /Failures (MTBO/MTBF). The survey motorboats are operated at sea for 8 to 10 hours continuously.

(b) Non Magnetic Engines. The minesweeping vessels are fitted with non-magnetic 250HP engines. Due to the specific role of the ships for undertaking minesweeping operations, it is essential that engines having non-magnetic characteristics be installed onboard. Presently, no indigenous diesel engine manufacturer is manufacturing non-magnetic engines. Indigenous manufacturers could enter into strategic tie-ups with reputed foreign manufacturers of Non Magnetic diesel engines viz. MTU Germany to develop indigenous competence and capability in this field for meeting requirements of the Navy.

2.9. **Reduction Gear**. For efficient power transmission to the propeller marine gearboxes should possess the following essential features

(a) Higher hardness of pinion and gear materials with attendant higher gear tooth loadings.

(b) High efficiency and reliability

(c) Long life

(d) Low noise levels.

2.10. Gearbox generated noise is a major factor in the overall under water noise signature of ship. Indigenous development of ultra low noise gearbox to achieve quieter operations is the need of the hour. Presently some gearboxes of ship are being manufactured in India under joint ventures with foreign firms such as M/s MAAG Switzerland, M/s Renk Germany. However the import content in the assembled gearboxes is high. There is a requirement of gearboxes with greater indigenous content in the range of 1-50 MW for the new construction ships.

2.11. **Air Independent Propulsion Solutions for Submarines (AIP)**. Indian Navy is also exploring AIP solutions for powering submarines as it offers considerable tactical flexibility by cutting down the indiscretion ratio thereby considerably improving the survivability of a non-nuclear submarine. Operational considerations

like quietness, shallow water capability, size and manoeuvrability issues have rekindled interest in non-nuclear AIP solutions of many frontline navies. Some of the AIP solutions tried out by foreign navies are **Stirling Engines**(Gotland Class of Royal Swedish Navy), **Closed Circuit Diesel(CCD)** Thyssen Nordseewerke (Germany and RDM Netherlands) ,**Fuel Cells** (German and Italian Navy's U212 with a PEM fuel cell pack by Siemens) and French **MESMA** Steam Turbine system. Sterling engines and closed cycle diesel AIP solutions are most developed and commercially available however electrochemical fuel cell and MESMA have good potential and have been focus of much of recent research. Indigenous competence in this field is still lacking or at a very nascent stage and is required to be built up to supply AIP solutions of the range of 225 to 250 KW for retrofitment on the existing submarines/ incorporation in the new designs.

Prime Movers for Generators

2.12. **Diesel engines, Steam turbines and Gas Turbine Prime Movers.** Diesel engines, steam turbines and gas turbine prime movers are presently used onboard IN ships for power generation. Diesel engines in the medium power range (50KW - 1500KW) are used for power generation. Steam turbines are used for generating power in the range of 500 KW to 1000 KW. Turbo alternators are presently being manufactured by HAL under license from M/s Allens UK.

2.13. Indigenous development / licensed production of **diesel engine** and **gas turbine prime movers** in the higher power range (1 to 3 MW) will enable import substitution and also provide prompt and reliable product support for the Navy.

Machinery Control Systems

2.14. **Machinery Control Systems.** To ensure substantial indigenisation in the next 15 years, the design of all machinery control systems for future shipbuilding programmes are being evolved around open architecture standards. This will ensure indigenous availability of core hardware as well as software of machinery controls on all new construction ships. For existing ships, conversion to indigenous equivalent designs has been planned for Corvette, SNF, Godavari Class, LST (JM) and P-16A class ships in the next 10 years and identification of suitable design is in progress.

2.15. **Engineering Instrumentation.** DME Specifications have been formulated for indigenisation and standardisation of all engineering instrumentation (Pressure gauges, 4-20mA gauges, pressure / temperature switches etc). Compliance to DME specs is mandatory for supplying instrumentation for the new construction ships and progressive replacement of the imported instrumentation fit for the ships in commission.

Auxiliary equipment

2.16. **Shafting/ Controllable Pitch Propellers(CPP).** At present some headway has been made in indigenous development of fixed pitch propeller shafting systems with foreign collaboration where the critical components such as propeller, stern tube bushes, 'A' Bracket Bushes, Plummer block bearings are still being imported. The import content in case of CPP shafting systems is much higher. There is need to indigenously develop CPP shafting systems with a greater indigenous content of critical component for the future indigenous ship construction projects.

2.17. **Propeller Shaft Sealing Arrangements.** Shaft sealing devices are required to prevent ingress of seawater through the stern tube. At present these shaft seals are being imported from foreign firms viz. Deep Sea Seals UK etc. There is a need to develop a reliable indigenous gland sealing arrangement for the shafting system of the new construction ships and also for replacing the imported assemblies installed on existing ships as and when due for renewal.

2.18. **Stabilisers/Steering Gears.** These constitute hydraulically powered stabilisers/steering systems with digital controls adapted for Naval warship applications. The systems include highpressure hydraulics including variable delivery pumps, hydraulic manipulators and rams having predominantly high precision high reliability hydraulic components. Presently, all critical hydraulic items (hydraulic pumps & control valves etc) and controls are being imported. Indigenous expertise in this field is yet to consolidate and may be facilitated by technical tie-ups with reputed foreign manufacturers.

2.19. **Propulsion System Integration.** Naval Ships are powered with suitable propulsion plants to meet the specified targets of speed, endurance, and manoeuvrability as per their envisaged roles. The propulsion plant could consist of a Diesel Engine, Gas or Steam Turbine or combination of these. In-depth studies are required for selection and integration of the prime mover, Gearbox and shafting arrangement for evolving an effective propulsion system to match the ships hull and tonnage. The propulsion system design and integration studies are presently being sub contracted to foreign ship designers and vendors. With a large number of indigenous ship building programmes envisaged in the future, there is a need for Indian industry to acquire adequate expertise and in house competence in Propulsion system machinery selection, design and integration studies.

2.20. **Air conditioning and Refrigeration Plants.** Air conditioning plants in the navy range from 30 tons to 500 tons capacity. Indigenous manufacturers are providing the lower range AC plants. Although Indian manufacturers are capable of supplying the higher range AC plants the import content for such plants is in the order of 50-70%. Also in the light of IMO regulations for phasing out of ozone depleting CFCs there is requirement to convert existing R-11 plants to operate on R-22 refrigerant. Indigenous industry has a large role to play in developing associated technologies for converting AC plants to run on R-22 / non-CFC based refrigerants. Also there is a requirement to indigenously develop screw compressors for higher capacity AC plants.

2.21. **HP Air Compressors.** Air Compressors are employed on board for variety of requirements like providing air for charging of breathing apparatus, starting of diesel engines and operation of weapon systems. The capacity, pressure and quality of discharged air is dependent on the end use. The large dependence on foreign sources for shipboard HP compressors in the required range has been reduced significantly by developing some Indian sources for replacing the imported compressors of existing ships. However there exists a large inventory of Soviet origin compressors of varying discharge pressure (200 to 400 bar) and capacity (upto 100 cubic mt / hour) and there is ample scope for indigenous substitution in this field.

2.22. **Control Air Compressors.** In order to provide oil and moisture free air required for operation of machinery controls, servo air compressors of import origin are fitted on board various ships. Recently M/s Atlas Copco, Pune, have successfully proved and supplied their control air compressors for Leander/Godavari class ships. Ample scope exists for other indigenous manufacturers to meet the requirements of new construction ships and replacement of imported compressors for ships in commission.

2.23. **Desalination and RO Plants.** All marine vessels, large and small require equipment for producing potable water for domestic consumption. In addition there is also a requirement of desalination plants to produce high purity water with maximum chloride content of 1 PPM for use as boiler feed water, Aircraft services and Battery fluid for submarine batteries. The Reverse Osmosis plants are being procured from a single indigenous source, which also has large import content. There is a requirement to develop additional indigenous sources of supply of the RO plants with considerable reduction in import content.

2.24. **Centrifuges.** A large number of Russian Origin Lube Oil and Fuel centrifuges are presently in use on board ships. Indigenisation of fuel oil centrifuges is in progress. Efforts are in hand to identify/ develop indigenous sources for manufacturing of lube oil centrifuges of capacity 1000 to 4000 litres per hour as replacement for soviet origin centrifuges.

2.25. **Centrifugal Pumps.** Fire pumps, AC and Ref plant seawater pumps, dewatering pumps, and fresh water pumps of Russian origin are fitted on ships. These pumps are of discharge pressure ranging from 2 kgf/cm² to 12 kgf/cm² and capacity 10 tons per hour to 250 tons per hour. Indigenous substitutes of these pumps are being developed through reputed Indian pump manufacturers. The volumes involved are quite substantial and should prove attractive for more Indian industry players to venture and meet the growing demands for new construction ships and replacement for imported pumps on existing ships.

2.26. **Gear/Screw Type Pumps.** Gear and Screw pumps are widely used on board for conveying POLs and combustible fluids due to their less turbulent pumping action. A small beginning has been made with replacement of Lub oil, fuel oil and AVCAT pumps of foreign origin with indigenous pumps developed by M/s Alekton and Tushaco Pumps. However, given the large numbers and diversity of the pumps there is ample scope for other manufactures to venture in his field.

2.27. **HP Air and Hydraulic System Valves.** Air and hydraulic system valves for high-pressure application (up to 400 bar) are not available indigenously and are being imported from UK and Russia for all the indigenous shipbuilding projects. These could be taken up for development by Indian valve manufacturers.

2.28. **Sea Water System Valves.** Sea water system valves are widely used in the critical systems of ships viz. fire main system, cooling water systems, pre-wetting system, ballasting/ de-ballasting systems etc. There is a recurring demand for valves in large numbers of sizes 25 mm to 250 mm. Premature failure of Gun metal sea water system valves has been experienced on some ships and Navy has now specified Nickel Aluminium Bronze (NAB) valves for sea water systems. This relatively low technology but high volume field presents an attractive opportunity for the industry to step in and supply reliable and quality products for Navy's current and future requirements.

Miscellaneous Equipment

2.29. **Fire Fighters Thermal Imaging Camera.** Thermal Imaging Camera's (TIC's) are used onboard ships by Fire Fighters for locating the source of fire in smoke filled compartments and also to locate trapped personnel. The TIC works on the principle of IR imaging with detector / sensing element with a vidicon tube or microbolometer. Presently fire fighters Thermal Imaging Cameras are being imported and there is a requirement to develop these TIC's indigenously.

2.30. **NBC Protective Suits**. The Navy has a requirement of Nuclear, Biological, Chemical protective suits for use by personnel in an NBC environments. The NBC suits should be of reusable type with preferably, spherical carbon adsorbed based technology. Also suits with non-woven / woven carbon fibres are acceptable subject to the condition that they meet all user requirements. Presently only the DRDO is in the process of developing re-usable NBC suits. Indigenous manufacture of the suits with technical collaboration from established manufacturers abroad would serve the large requirements of all the three services.

2.31. **Fire Fighters Protective Clothing**. There is a requirement to develop Nomex based fire fighters approach suits for use onboard ships during fire fighting operations. The Nomex based protective suit should meet the Naval requirements, which are based on EN 469 an International Standard for fire protective clothing.

2.32. **Acoustic Enclosures.** Gas turbines, Diesel engines, forced draught blowers etc are inherently noise generating equipment. With increasing emphasis on stealth, Navy is engaged in finding ways and means to attenuate the radiated noise levels. Acoustic enclosures are one of the ways to suppress the airborne noise to acceptable levels. Suitably marinised versions of COTS acoustic enclosures can be readily adapted for auxiliary machinery.

2.33. **Infrared (IR) Suppression Devices.** Significant improvements in IR sensing devices make ships increasingly vulnerable to IR detection and IR seeking missiles. There is a need to develop IR suppression devices to reduce IR signatures

of the ships and increase its survivability. These devices include suppression devices for exhaust gases from Gas turbines and Diesel engines and active hull cooling systems for reducing solar heating of the hull. This is a practically unexplored field for the industry and they can work in consultation with the DRDO organisation for an initiation into IR suppression systems.

Forecast Requirements

2.34. A list of forecast requirement of Engineering equipment and systems for the next 15 years is placed at **Appendix 'A'.**

CHAPTER 3 - ELECTRICAL/ ELECTRONIC SYSTEMS

3.1. Products like Generators up to 500KW, Automatic Voltage Regulators (AVRs), Switchboards, Air and Moulded Case Circuit Breaker, Automatic Flood Warning and Fire Alarm System, Electrical cables of different capacities, Lighting Systems, Automatic Emergency Lanterns (AELs), Hot Plates and Deep-fat Fryers for ship's galley etc. have been developed and supplied by the Industry.

3.2. In the recent past, resources of the indigenous industry have been tapped for products like Microprocessor Based Air Circuit Breakers, Automated Power Management System (APMS), 1MW Generators, Command and Control Systems, Multi-Function Displays, ATM based data bus, Control System for Remote Control Target Boat (RCTB), Rotary and Static Converters/ inverters etc.

3.3. In addition to the above the participation of the industry for production of the under mentioned Electrical/ Electronic equipment, amenable to indigenisation needs examination.

(a) **Gyros.** Till recently all Western & Russian gyros in use by Indian Navy worked on the principle of rotating mass for angular measurement reference. However, presently Navy is inducting new generation gyros like Ring Laser Gyros (RLG). These are being procured from abroad and Navy would like to have manufacturing of such gyros based on latest technology (like RLG or fiber optics) to be available in India for better system availability and product support.

(b) **Logs.** Navy is using Logs to obtain ship’s speed based on electro-magnetic measurement concept and these Logs are required to give a high accuracy for integration with various weapon control systems and for navigation. The output of the Log gets affected by shape of the ships hull. Though M/s Keltron has indigenised Log systems for the Navy, the technology is of late 80’s vintage. Indigenous development of modern logs and their data transmission units is thus required to be undertaken completely in India.

(c) **Echo Sounder.** The echo sounders play an important role in depth sounding especially for a ship’s navigation. M/s Keltron is presently supplying echo sounders for Naval ships. However, Navy is looking for modern indigenous echo sounders, which can be networked with ship’s data bus system for real time information availability.

(d) **INMARSAT.** Indian Navy is presently dependent solely on INMARSAT consortium for satellite communication needs. However, Navy plans to go in for a secure mobile satellite network based on indigenous INSAT satellites for its tactical and strategic communication to avoid dependency on the foreign INMARSAT satellites whose security could be compromised.

(e) **GPS.** With evolution of technology, GPS has become necessary navigational equipment for ships and its data is used as reference for data transmission amongst various shore & sea based units. USA controls the

GPS satellites and the higher accuracy of the system is provided for use exclusively to NATO countries. (Navy is interested in a secure higher accuracy positioning system in similar lines as GPS). Whilst setting up a network of GPS satellites in the country is beyond the scope, it is proposed that at least the GPS receivers are indigenised with capability to be interfaced with ship's weapons and sensors.

(f) **Microprocessor Based ACBs.** The conventional Air Circuit Breakers (ACBs) of various ratings are currently sourced from different indigenous vendors including GEPC, Siemens etc. L&T has also offered their ACBs for evaluation. However, recently, microprocessor based release mechanism for the ACBs have been introduced, which though available locally, are being sourced from abroad. There is a need to indigenise these microprocessors so that the state of the art ACBs are totally indigenised.

(g) **Static Frequency Converters.** The required specific secondary supplies for systems like gyros & radars are derived from the ship's main supplies by using separate rotary frequency converters which have inherent maintenance problems due to moving parts along with EMI/EMC problems. Static frequency converters are better suited for such applications and need to be designed and developed in India.

(h) **New Generation Zero Maintenance Batteries.** Onboard a ship batteries are used for providing control, firing and back-up supplies for various systems. Presently, lead acid batteries are being used for these purposes but they have many problems related to their maintenance and handling onboard a ship. Advanced generation maintenance free batteries with high cranking amps & high deep discharge capability are going to be a suitable replacement for lead acid batteries.

(j) **Flat Panel Displays (FPD).** Presently CRT based displays used for various systems onboard ships are getting obsolete and there is a requirement to replace these as a retrofitment with FPDs. This will involve circuit modifications for various voltage levels etc to achieve integration of the displays with existing systems like multifunction consoles of Radars.

(k) **Development of Capability for Integration of Surveillance/ Weapon Delivery Systems.** In any new construction ship the integration of weapons, sensors and other equipment onboard ships is generally carried out onboard a ship after all equipment have been installed and individually tested/proved. The data flow between systems uses highspeed data bus which by it self also needs to be tested at the first instance. All these activities lead to an inordinate delays leading to non-availability of a fully capable ship in time. There is an urgent need to develop expertise within the country, who can take on the role of a System Integrator.

(l) **Energy Efficient Fluorescent Lights.** Substantial advancement in the technology related to lighting and associated systems have take place in the last decade such as evolution of systems like DALI (Digital Addressable Lighting Interface) for remote & intelligent control of lighting circuits. Use of

Compact Fluorescent Lamps (CFLs) and LED cluster for lighting are replacing the conventional incandescent lamps. These developments have special relevance for Navy from the point of view of exploitation onboard a ship with regards to various EMI/EMC aspects, shock & vibration and installation issues.

(m) **Automatic Fire Detection System with Intelligent Sensors.** With advent of intelligent sensors now more sensitive fire detection sensors are available with false alarms and transducer maintenance issues being overcome with integration of sensors & centralized control. It is possible to integrate intelligent lighting system with fire detection & fire fighting system via a common data bus.

(n) **Automated Power Management System (APMS).** APMS is a new system being planned for induction by Navy for the first time and is yet to be proved for new construction ship. There is however no technology Know how and Know-why of such systems within country. In order to exploit the automation in power generation and distribution systems, these systems are going to be installed onboard all future warships.

(p) **Soft Starters.** Onboard a ship, a number of different types of AC induction motors are used with their associated Star-Delta/DOL starters for starting. Presently, soft starters are another form of reduced voltage starters available for induction motors hich have better protection & reliability features. Soft starters employ solid state devices to control applied voltage and hence the current to the motor.

(q) **Modems.** Navy is in the process of incorporating a high speed online data & voice encryption/decryption device in the existing Satcom systems in order to obtain message security as per defence approved crypto overlay. Such devices have not been developed/productionised by any manufacturer within India.

(r) **Electronic Chart Displays.** The overall objective of the ECDIS is to enhance navigational safety of a ship. ECDIS equipment provides the necessary ability to select, display, and interpret relevant information, including the use of navigational functions associated with route planning and monitoring; and knowing what proper action to take in case of malfunction. There is a need to have production of the system in India along with training to overcome ECDIS-related limitations, particularly those associated with errors of interpretation & over-reliance.

(s) **Nav Radars.** The X-band navigation radars used onboard a ship are required to be incorporated with various ECM features like low probability of intercept (LPI) without degradation in system performance in a complex electro-magnetic environment. These radars are generally extremely low power CW radars with complex signal processing and capable of detecting targets beyond 24 NM without being picked up by ships EW systems. Development of such radars within the country could be explored.

(t) **Command & Control System.** Command, Control, and Communication (C^3) system is an information system employed within Navy which incorporates strategic and tactical systems like a combat direction system, tactical data system, or warning and control system with associated human function. It is an integrated combination of people, procedures, and hardware used to enhance the ability of the individual performing command and control. Thus, it must necessarily complement the needs of the commander. The increasing need for responsive Command & Control systems is being driven by the rapidity with which weapons can be deployed. In a complex multi-threat combat environment, automated combat direction systems make it possible for people to deal with a large number of targets and compressed reaction times of modern warfare. The complex C^3 functions required to keep track of hundreds of friendly, neutral, and enemy ships, aircraft, and weapons, while engaging only those permitted by the current rules of engagement, would be impossible by manual methods. In Navy it is felt that C^3 system needs to be systematically designed as, in many cases, isolated systems were introduced in response to perceived needs or to take advantage of existing technology. C^3 systems are required to be developed to incorporate following areas in support of commanders engaged in command and control:

(i) Reconnaissance and Surveillance.

(ii) Environmental Observation and Forecasting

(iii) Intelligence Analysis

(iv) Electronic warfare

(v) Navigation

(vi) Management

(vii) Strategic and Tactical Weapons Deployment

(viii) Logistics and Supply

(u) **Development of Indigenous High Speed Data Link for CAIO.** The Indian Navy is in the process of development of a tactical and messaging data link. The software and hardware is being developed in-house. This data-link will be productionised through indigenous manufacturers.

(v) **Multifunction Consoles (MFC).** Integration is the key to successful system design. In MFC, Sonar, TV video, radar video etc can all be displayed on the same console, using an embedded system or based on a standard workstation or PC. Such a system needs to be productionised within the country for better system availability and product support.

Forecast Requirements

3.4. A list of forecast requirement of Electronic/ electrical equipment and systems for the next 15 years is placed at **Appendix 'B'.**

CHAPTER 4 - WEAPONS AND SENSORS

4.1. With the restricted availability of critical weapons and sensors spares from erstwhile USSR, and denial of license to import critical components from USA under sanctions, greater thrust has been given to indigenisation of critical systems. Indigenous developments, in the case of weapon and sensor systems in the Navy, are being undertaken through ab-initio design and development route. This option has been further enforced due to denial of critical core technologies to the nation as well as lack of adequate in-house R&D facilities existing with the industry. Accordingly, design of prototype weapon and sensor systems is undertaken by DRDO.

4.2. The Development and Evaluation model (D&E), thus developed, is subjected to extensive user evaluation trials and the design frozen before clearance for production. At this stage, production agency is normally selected on competitive basis. In this option of ab-initio design and development, dedicated user evaluation trials is required before freezing of the system design thereby causing delays in induction of the system. Most of the design efforts in the field of Anti-Submarine Warfare, in terms of sensors and Weapons, are being indigenised through this route.

4.3. However, in the case of indigenisation of weapon systems through Reverse Engineering, the industry is approached directly, to undertake a pilot sample. Batch production clearance (BPC) is accorded after trials of the pilot sample and meetings of Naval staff quality requirements (NSQRs). Industries for indigenisation of these components are selected from the set of industries registered with DQAN as meeting the requisite QA standards in terms of production and material usage. In the case of weapon launchers, involving mostly micro-controllers based elector-mechanical systems, the second option of reverse engineering is adopted.

4.4. Private industry has been involved in manufacture of various components/ spare parts of Naval weapon and sensors. A few leading examples are enumerated below :-

(a) Manufacture of SSM Loading Gear of P-20/21/22 Missiles.

(b) Fabrication of Magnetic Influence Mine Sweeping Cables TEM-3 and AT-2.

(c) Development of Torpedo Guide Strips for Submarines.

(d) Manufacture of Emergency Recovery System for Towed Array Sonar.

(e) Manufacture of Hydraulic Test-jigs for Towed Array Sonar

4.5. Indigenisation of spares and components are being progressed on a case to case basis. Some of the spares which are being indigenised are as follows :-

(a) Electronic components like Diodes, Capacitors, Resistors, etc.

(b) Transformers of various ratings.

(c) Fuses & Fuse Links of various ratings.

(d) Lamps of various sizes, voltages, wattages and colours.

(e) Electrical switches and switchgears of various ratings and sizes.

(f) Electro-mechanical relays of various sizes, voltages and contacts.

(g) Mechanical components of Guns like Rollers, Bushes, Catch units, etc.

(h) Connectors, male and female, of various sizes, ratings and types

Forecast Requirements

4.6. A list of forecast requirement of Weapon systems and sensors for the next 15 years is placed at **Appendix 'C'**.

CHAPTER 5 – SUBMARINE EQUIPMENT AND SYSTEMS

Existing Submarines

5.1. Indigenisation in submarines has been limited to few low end technology items and important critical weapon systems. This probably is due to the fact that submarine equipment and systems are required to conform to stricter and superior material and quality standards as compared to surface ships. This may be seen along with the fact that we as a technology driven nation is still evolving as submarine designers and more so in the design of equipment and systems catering to under sea applications. The indigenisation requirements of the submarines of erstwhile Russian origin are limited due to the declining residual life of these classes of submarines.

5.2. Not withstanding the above, private industry has been the corner stone of whatever indigenisation that has been undertaken by the Navy for the submarines. Some examples of indigenisation, which are undertaken in the recent past include:-

(a) Hydraulic oil accumulators

(b) Fuel flow meters

(c) Various system filters

(d) Various pumps

(e) Various types of cables

(f) Submarine batteries

(g) System coolers

(h) Various types of sensors and indicators

Project -75 Submarine

5.3. GoI has concluded contractual agreements with the French Government for design, construction and TOT of Scorpine class submarines. This has offered an excellent opportunity for indigenisation of equipment and systems as per the provisions of the contracts. Equipment and systems proposed to be indigenised are as follows:-

(a) HP Air Bottles

(b) Heat Exchangers

(c) Battery

(d) Bladder Accumulators

(d) Various Filters

(e) Air Conditioning Units/ Ref Plants

(f) Air Conditioning Plants/ Valves/ Flaps

(g) Air Conditioning Plants/ Heat exchangers

(h) HP Air Compressor

(j) Various Pumps

Forecast Requirements

5.4 A list of forecast requirement for EKM and SSK class of submarines is placed at **Appendix 'D'**.

5.5 A list of forecast requirements for Project – 75 submarines is placed at **Appendix 'E'**.

Appendix-A

FORECAST REQUIREMENT OF EQUIPMENT AND SYSTEMS
MARINE ENGINEERING EQUIPMENT

Equipment		2008-12	2013-17	2018-22	Total (No)
Gas Turbine	20MW 10MW		20 GT(20MW 06 GT(10 MW)	----	26
Diesel Engines	<1MW 1-2.5 MW 2.5-10 MW 15 mw	24(900 KW) 02 (15 MW) 12 (5 MW)	120 (1MW – 2.5 MW) 14 (6 MW)16 (~ 2.5 MW)	----	188
Gear Boxes	<1 MW 1-2.5 MW 2.5-10 MW 15 MW 30 MW	24 (900 KW) 02 (15 MW) 06 (10 MW)	60 06 (30 MW) 14 (30 MW) 16 (~ 2.5 MW)	----	122
Shafting	<1 MW 1-2.5 MW 2.5-10 MW 15 MW 30 MW	24 sets 02 sets 06 sets	60 sets 06 sets 14 sets 16 sets	----	122 sets
Steering Gear	Rotary vane other	12 (rotary vane type) 02 sets 06 sets	60 sets 06 sets 14 sets 08 sets	----	108 sets
Stabilisers		03 sets	06 sets 14 sets 03 sets	----	26 sets

Machinery Control system		06 01 03	120 03 07 08	----	148
DAs (Prime Movers)	100-250 KW 0.5-1 MW >1 MW	24 (12-250 KW, 12-150 KW) 04 (2 MW) 12 (500 KW)	120 (100 KW-200 KW) 03 (1 MW) 24 (1 MW) 24 (500 KW)	----	211
Air Conditioning Plants	40 TR 144 TR	18 (40 TR) 03 (144 TR) 15 (40 TR)	-- 18 (144 TR) 42 (144 TR) 18 (40 TR)	----	114
Refrigeration Plants		03 06	06 14	----	29
Centrifuges		06 04 12	120 24 48 32	----	246
Air Compressors		12 02 09	200 12 14 24	----	273
Reverse Osmosis Plants	10 TPD 30 TPD <10 TPD	12 (10 TPD) 03 (30 TPD) 09 (30 TPD)	- -9 (30 TPD) 21 (30 TPD) 16 (4 TPD)	----	70
Pumps		60 40 30	500 40 40 40	----	750

IPMS		06 01	03 07 08	----	25
Bow Thrusters		----	08	----	08
Azimuth thrusters			16	----	16
Turbo Alternators	750 KW	06	----	----	06
FD Blowers		06	----	----	06
Replacement Material for Auxiliary Boiler of SNF		10	----	----	10
Pumps	Centrifugal Positive Displacement	222 144	190 168	----	724
Propulsion Integration Study		4	5	----	9
Thermal Imaging Camera		----	100	----	100
Fire Fighting Suits		800	----	----	800
AIP Solutions		4	4	----	8
NBC Suits		2000	----	----	2000
Acoustic Enclosure		60	60	----	120
IR Suppression Devices	GT IRSS DE IRSS	12 12	16 16	----	56
Marine Valves	Sea Water Systems Stm. Systems 1200 Psi HP Air Systems Miscellaneous	Large Quantities			

Incinerator	10	7	3	20
Propulsion Control System	10	7	3	20
GTG	10	5	2	17
Diesel Oil Transfer Pump	20	20	10	50

Appendix-B

FORECAST REQUIREMENT OF EQUIPMENT AND SYSTEMS
ELECTRICAL / ELECTRONIC SYSTEMS

EQUIPMENT	2008-12	2013-17	2018-22	TOTAL
Automatic Fire Detection System	10	10	10	30
New generation Helo Starting Rectifier	05	10	10	25
GT Starting Rectifier (1241 RE)	06	06	06	18
GT Starting Rectifier (SNF/DELHI CLASS)	04	04	04	12
GT Starting Rectifier	05	05	05	15
Dynamic Loading Device for GT Starting Rectifier	03	03	03	09
New Generation Rotary Convertors	05	15	15	35
Development of Navigational Radars (X Band) with LPI capability	40	30	30	100
Development of capability for integration of various surveillance/weapon delivery systems	10	5	10	25
RRB	30	40	30	100
Multi Functional Radars	10	10	10	30
Development of New Generation Gyro	30	30	40	100
Development of New Generation Log	30	30	40	100
Development of New Generation Echo Sounders duel as well as single channel	20	10	10	40 each

Appendix-C

FORECAST REQUIREMENT OF EQUIPMENT AND SYSTEMS
WEAPON SYSTEMS

EQUIPMENT		2008-12	2013-17	2018-22	TOTAL
Missile System	Front Safety mechanism	05	05	05	15
	Dummy Missile	02	02	01	05
	Communication Unit	03	04	03	10
	Safe and Arm device	05	05	05	15
	Auto pilot				15
	Altimeter	05	05	05	15
	Power supply assembly	05	05	05	20
	Proximity fuse	03	04	03	10
Missile System	Missile extraction trolley	01	01	----	02
	Platform for clustering	02	01	----	03
	Cross piece	02	01	----	03
	Display Unit of AKPA 6.3	02	01	01	04
	Radio Altimeter	05	05	05	15
	Attenuator	02	02	01	05
	Antenna assembly	02	02	01	05
	Delay Line	02	02	01	05
	Torsion bar	05	05	05	20

AK-100 Gun Spares	13 types	----	----	13 types
30mm Kashtan Gun spares	12 types	----	----	12 types
A-190E Gun Spares	13 types	----	----	13 types
AK-726 Gun Spares	92 types	----		92 types
SRGM 76/62 Gun Spares	103 types	----	----	103 types
Safety Solenoid for 7.62mm Air Version Gun	25	----	----	25

Appendix-D

FORECAST REQUIREMENT OF EQUIPMENT AND SYSTEMS

SSK / EKM SUBMARINE EQUIPMENT AND SYSTEMS

ITEM	2008-12	2013-17	2018-22	TOTAL
SSK				
AC CW Pump with motors	4	4	----	8
Piston Bilge Pump-I	2	2	----	4
Piston Bilge Pump-II	2	2	----	4
Propeller Shaft	1	1	----	2
Bush (SACH-NR-144280)	1	1	----	2
Bush (SACH-NR-014598)	1	1	----	2
Cockpit Mast Snorkel	1	----	----	1
Pneumatic Ejecting Device	1	1	----	2
Piston Rod (FWD)	2	1	----	3
Piston Rod (VR)	1	1	----	2
Piston Rod (AP)	1	1	----	2
Pressure Cylinder (Type 64DIA 130)	2	----	----	2
Pressure Cylinder (Type 64DIA 100)	3	----	----	3
Pressure Cylinder (Type 64-AZ/P2-DN 300)	3	----	----	3
Pressure Cylinder (Type 64-AZ/P2-DN 400)	2	----	----	2

EKM					
Generator Tacho		2	3	----	5
Battery Breaker		2	2	2	6
Armature breaker		2	2	2	6
Electric Bilge Drying Pump		12	12	12	36
DC network insulation measuring unit		3	2	----	5
AC network insulation measuring unit		3	2	----	5
Unit P 12 G		6	6	----	12
Coupling Indication System	8 WMC	4	4	----	8
	11 WMC	2	2	----	4
Refrigerating Plant (without Evaporators)		2	3	----	5
Lub Oil Priming Pump		6	05	05	16
Generator Air Cooler		6	05	05	16
Main Motor Cooler		4	03	03	10
Reserve Motor Air Cooler		4	03	03	10
Cooler for Closed Loop Ventilation of Batteries		4	03	03	10
Depth Gauges (0-40)		8	06	06	20
Depth Gauges (0-400)		10	08	07	25
Hydraulic Manipulators (GEM 2-10-5)		80	75	70	225
Hydraulic Manipulators (GEM 4-6-5)		40	35	30	105
Electromagnetic Blowing Valves		12	10	8	30
Electromagnetic Blowing Valves `Q' Tank		2	2	1	05
Three Position HP Air Column Group Valves		16	16	12	44
Two Position HP Air Panel Valves		30	25	25	80
Electromagnetic Drain Valves of Auto Blowing System		10	8	6	24

HP Air Reducers 45 to 06 KG/CM2	12	10	8	30
Sea Water Valve (Shut Off Angle Union D 20 P 100)	60	50	45	155
Sea Water Valves (Shut Off Brass Angle Union D 10 P 100)	40	35	30	105
Sea Water Valves (Angle Union Shut Off D32 P 100)	35	30	25	90
Air System Valves (Angle Stop Valve D 32 P 400)	30	40	30	100
Air System Valves (Angle Stop Valve 10 P 400)	30	25	20	75
Air System Valves (Angle Stop Valve D 15 P 400)	25	20	15	60
Breaker Circuit 2XAB 50-42	4	4	4	12
Tacho Generator Type (G) 12T3	4	2	4	10
Hydrogen Burner (P) (D)-3ATM4	4	2	4	10
Fan PCC 2.5/25, 1-2.9 K (P) 0, AC Blower	4	4	4	12
Fan PCC 216/10-1,1.9(L) 0, Galley Blower	4	2	4	10
Fan PCC 216/10-1, 1.9(L) 270 Compartment Blower	4	2	4	10
Electric Fan PCC 63/40-1-29:K(L) 90 Supply Blower	4	2	4	10
Electric Fan PCC 63/40-1-2-9:K(L) 90 Exhaust Blower	4	2	4	10
Fan PCC 8/25-1-1-9(L) O, Standard Blower	4	2	4	10
Fan PCC 100/40 P Main Motor Blower	4	2	4	10

DC Motor Generator Blower/HYD Pump	4	2	4	10
DC Motor Main Motor Blower	4	2	4	10
DC Motor AMK-10	4	2	4	10
DC Motor EK-10	4	2	4	10
DC Motor Supply/EXHST, Blower	4	2	4	10
Circuit Breaker Tyep A 20 1,2,3,4	8	4	8	20

Appendix-E

FORECAST REQUIREMENT OF EQUIPMENT AND SYSTEMS

P-75 SUBMARINE EQUIPMENT AND SYSTEMS

ITEM	2008-12	2013-17	2018-22	TOTAL
HP air bottles	04 sets	-----	------	04 sets
Heat Exchangers	04 sets	-----	------	04 sets
Battery: Battery cells. Fitting and connections	04 sets	-----	------	04 sets
Bladder Accumulators : Separate olepneumatic accumulators	04 sets	-----	------	04 sets
Various Filters	04 sets	-----	------	04 sets
Air conditioning Units / Air Heaters and refrigeration Plants	04 sets	-----	------	04 sets
Air conditioning Plant: valves/ Flaps	04 sets	-----	------	04 sets
Air conditioning Plant: Heat Exchanger	04 sets	-----	------	04 sets
HP Air Compressor	02 sets	-----	------	02 sets
Pumps- Various types of Pumps	02 sets	-----	------	02 sets

Note: One set comprises of various quantities