The first issue of SP’s Naval Forces for 2010 coincides with the Defexpo being held at Delhi from February 15 to 18. We at SP Guide Publications are proud to state that we are the sole and exclusive publisher for official Defexpo Dailies, publishing the show news dailies and the show flyer. The cover story, thus, befittingly is modernisation of the Indian Navy which covers sub surface, surface and the fleet air arm aspects comprehensively.

This is followed by an article on Littoral Warfare which is going to effect the future naval operations. US Navy has already commissioned two ships specially tailor made for such a role and many more are on the anvil.

An insight into the Aegis missile system has been given by no less a person than Admiral Robert J. Natter, former US Navy’s Commander of the US Atlantic Fleet and Fleet Forces Command. E-2D Advanced Hawkeye is the navy’s eye in the sky for air defence which can fit very well into the overall air defence environment of any country’s navy thus an overview of the offer from US is included in this issue.

The article on naval aviation gives a focused glimpse into the future of this very important branch of the navy. The articles on Network Centric Operations, naval UAV’s and naval armament cover the current and future scenario, and options for the Indian Navy.

Considering the fact that Defexpo 2010 is devoted to the defence industry, it was pertinent to give a rundown on the naval shipbuilding scene in India.

In an article on shipbuilders, the writer makes a case for the future blueprint to be built through mergers, consolidation, diversification and exports. It also includes a performance review of the three Indian Navy shipyards to include current and future shipbuilding plans, balance sheet and plans for modernisation of their infrastructure.

Besides inducting technologies from varied sources, the Indian Navy has also built up indigenous capabilities in warship designs and constructions.
done as part of the mid life update (MLU) and is generally confined to weapons and sensors. A ship's life is generally 25 to 30 years, but in Indian conditions it can be stretched beyond the life span usually guaranteed by the manufacturer. Thus, the MLU update can be any time between 12 to 15 years. At present, a comprehensive modernisation package is being undertaken during the MLUs of the SS-KeEMK Class submarines, and SNF and Godavari Class ships for the upgradeation of weapons and sensors. While the EKM class modernisation package is being carried out at the Russian shipyards, work on the remaining platforms is being done in India. Godavari Class: Godavari, Goroti and Ganga, that came into service around 1985-1988, are due for MLU, especially for weapons and sensors. The update is being carried out at Naval Dockyard, Mumbai largely with fitment of indigenously developed sonars, radars and communication systems. Rajput Class Destroyers: This class has five ships—Rajput, Rana, Ranjit, Ranvir and Ranvijay—which came into service in a phased manner beginning from the early 1980s. MLU of Rajput class is being undertaken by Naval Dockyard, Vishakhapatnam. While surface-to-surface supersonic missile BrahMos would boost the fire power considerably, long range surface-to-air missile capability with performance of Russian KBM missiles has since been successfully resolved.

Naval Aviation

Fixed Wing Aircraft

IL-38s: The modernisation of IL-38 aircraft has progressed quite successfully, enhancing its surveillance capabilities manifold. The aircraft has been refurbished with state-of-the-art avionics. Some outstanding issues related to the installation of Dragon suites have been amicably resolved and are now operational.

TU-142M: The replacement plan for ageing Long Range Maritime Patrol Aircraft TU-142M has progressed well.

Many globally renowned aircraft manufacturers have enthusiastically participated in the global tender for Maritime Fixed Wing Anti-Submarine Warfare Aircraft. Extensive field trials have been conducted with the short listed bidders and final contract for eight PFI aircraft has been signed which is due for simultaneous induction into the US Navy and IN. Delivery of the first aircraft for the IN is scheduled for 2012/2013 and thereafter one aircraft each year.

Dornier: The Dornier fleet has been augmented by inducting 11 other aircraft, some with Para-drop capability and the remaining to be beef up short-range and medium-range maritime surveillance role. To improve the identification capability, Forward Looking Infra-red system has also been installed.

Islanders: With a view to cover the capability gap between long range and short range maritime surveillance, a case is being processed for the Medium Range Maritime Reconnaissance (MRMR) aircraft. Procurement of six MRMR aircraft is being sought as a replacement for the ageing Islander 2T aircraft. The requirement to the global RFP has recently been received and technical evaluation of the proposals is in progress. Equipped with state of the art weapons and sensors such as air-to-surface missiles, surveillance radar, ESM and COMINT, the induction will augment the medium range maritime patrol capability. On conclusion of the contract, the aircraft would be inducted during the 13th Five Year Plan.

Rotary Wing Aircraft

Sea Kings: Proposed upgradation of the Sea King HU-21 fleet to an indigenous radar system and indigenous Electronic Support Measures (ESM). The technical evaluation is well under way to find a suitable replacement for the Sea King 42 and 42A helicopters in three variants, anti-submarine, anti-surface vessels and communication roles. Kamovs: The surveillance capability of the Kamov 25 and 28 has been enhanced with the installation of indigenous ESM package. The Kamov 31s are the new induction into the helicopter fleet and additional Kamov 31 AW are being contracted.

Adventurer Helicopter: Eight utility version of the ALH constructed at Hindustan Aeronautics Limited have been inducted into the helicopter fleet. However, the Naval Staff Qualitative Requirements prescribed for the utility helicopter to perform anti-submarine warfare and communication roles has not been met by HAL. Hence, fresh request for information has been issued to leading global helicopter manufacturers like the Bell, Boeing, Eurocopters, etc.

Strike Aircraft

MiG – 29K: Delivery of first batch of three of MiG-29K, the marine version for operating on board INS Vikramaditya (formerly Admiral Gorshkov) was affected and delivery of balance 13 aircraft contracted along with Admiral Gorshkov would take place in a phased manner. Pilot training programme to operate the aircraft was satisfactorily undertaken in collaboration with US Navy. The aircraft is equipped with Extended Range. Beyond Visual Range missiles, with smart bombs and mid air-buddy tanker facility from another MiG 29K aircraft for deep penetration role. Additional contact for 24 MiG 29K is as an advanced stage of conclusion which would take care of air war of Indian Aircraft Carrier (IAC), as well.

Sea Harriers: Upgradation programme for Sea Harrier aircraft with Derby-Beyond Visual Range missiles has been accomplished. As many as 14 Sea Hawks will be upgraded at the cost of $ 300 million (Rs 560 crore).

Light Combat Aircraft (Naval): This naval variant is under development at Aeronautics Defence and Research Organisation. It is being looked upon as an aircraft with significant air defence and strike capability. In addition, global RFP for the missile system for multi mission role combat aircraft for carrier borne operations has been issued to all leading manufacturers for Indian Naval Aircraft Carrier programme.

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DEFEXP INDIA exhibition held biennially in Delhi, is one of the most representative arms shows in the region. Russia's companies have constantly participated in this show of the land and naval armaments since its first edition in 2000, displaying their best products.

Russia is a long-standing and reliable strategic partner of India. Military-technical cooperation dates back to November 1964, when the first agreement was signed to supply MiG-21 aircraft to India. The Soviet Union also committed to export light tanks worth US$ 110 million and 20 helicopters.

In November 1965 the partners concluded a deal on the export of Soviet submarines. Later, large batches of MiG-series fighters, Mi-4 helicopters, military vehicles, guided shells and ammunition were delivered to India. A license agreement was signed in November 1970 to manufacture improved MiG-21 fighters at Indian aircraft enterprises.

Project 877KEM submarines were delivered to India in late 1990s - early 2000s

In March 1992, a protocol was signed under which Russia gave India a large credit to purchase military equipment. Later, India received MiG-29 and MiG-29UB aircraft from Russia. In 1994, contracts were secured for the construction of combatant ships. During the following year the Indian Navy received Project 877 submarines. November 1996 was marked by an agreement on the purchase of Su-30MK series multi-role fighters. In the same year a contract was signed to deliver Russian Tunguska-M missile/gun SP ADS and India also bought a large number of 130 mm M-64 field guns from Russia.

The year 1997 became an important milestone as the parties entered into a contract for the construction of frigates for the Indian Navy. All the ships had been handed over to the Indian Navy according to schedule. In the same year, Russia and India held talks on the licensed production of Su-30MKI.

In December 1998 the partners signed the Agreement on implementing the MTC Program through 2010 and a MoU concerning the transfer of the heavy aircraft-carrying cruiser Admiral Gorshkov to the Indian Navy. Six months later they agreed on training of the Indian military specialists in the RF MoD’s higher educational institutions. In the same year India's MoD decided to buy the T-90S tanks. An accord was reached to transfer a license to India to produce the V-31 diesel engines powering these vehicles.

In July 2000, a handover ceremony of the last Project 877KEM submarine in a series of ordered boats to the Indian Navy was held. Russia also supplied the newest weapons for these submarines. Aside from torpedoes, the submarine built in 2000 was armed with 3M-54E1 missiles being part of the latest Club-S anti-ship missile system. The Club-N missile systems with 3N-54E1 missiles were installed on Project 11356 frigates.

In March 2000, India received the first batch of Krasnopol-M laser-guided artillery projectiles. A contract to deliver Mi-17 military transport helicopters was secured to be used in the Himalayan highlands. In the same year the guided-missile frigate Brahmaputra built with Russian technical assistance was commissioned. The modern Ural anti-ship missile system made up the backbone of the frigate's armaments.

A 2006 contract to build Project 11356 frigates became a new step. They are designed to combat against surface ships and submarines, effectively operate as escort ships, repel air attacks, both independently and as part of naval forces. In terms of firepower, the frigate has actually caught up with the cruiser as a ship of the twenty-first century. It will be equipped with modern computer systems, while its combat data system will be able to identify all possible threats and propose the most effective ways to neutralize them. None ship of the Indian Navy offers such a high level of computerization. A distinctive feature of the frigate armaments will be the newest Brahmos missile system. Its missile has a reduced radar signature and can fly at extremely low altitudes at supersonic speeds. “This is a world-class cruise missile” - said Prime Minister Manmohan Singh. The frigates are now under construction at the Yantar Baltic Shipyard, Kaliningrad. They will be handed over to the customer in 2011-2012 and will remain in service up to 25 years.

A 2007 contract to supply a large batch of T-90S MBTs to India, which is being successfully fulfilled, became a milestone. The first batch of T-90S built at a plant in Avadi from Indian- and Russian-made components was handed over to the Indian Army in August last year. Russia has transferred such technologies only to India to manufacture this unique gun/missile MBT. For a long time India had accounted for one third of the Russian arms exports. As a result, 70% of the Indian Army’s hardware is Soviet- and Russian-built weaponry, while the total Russian arms exports have exceeded US$ 35 billion. Over the last two years the share of naval equipment has reached 9-10%, of all Rosoboronexport’s export deliveries, reaching US$ 6.5 billion. Rosoboronexport offers over fifty projects of warships and submarines.

Project 677 Lada submarine is successfully operated by the Russian Navy

The political aspect of our cooperation is vital. Russia never supplied weapons to Pakistan, while Germany and France have armed this India’s longtime rival. According to Western media reports, Pakistan is buying three Type U-214 submarines from Germany. The estimated cost of the deal exceeds US$ 1 billion. The boats will be supposedly built at Karachi Shipyard and Engineering Works (KSEW) under the supervision of Germany’s Howaldtswerke-Deutsche Werft AG (HDW). In 1994 a US$ 950 million Franco-Pakistani agreement was signed on the construction of three French Agosta-90B class attack submarines commissioned by the Pakistani Navy between 1999 and 2008.

The Indian arms market is estimated at US$ 30 billion in the next five years. Russia’s goal is to keep its status as the main partner of India with a good reason to achieve this. In October 2009, during the 9th session of the India-Russia Intergovernmental Commission on Military-Technical Cooperation, a new plan for strategic cooperation in MTC for the period of 2010-2020 was signed. India has no such agreements with other arms exporters.

Today, the bilateral cooperation is moving to a new level: from weapon deliveries to in-depth joint R&D, acquisition of Russian technologies, and establishing licensed production in India.

“Such a factor as confidence continues to play a crucial role in our relations with India,” - said Rosoboronexport’s Deputy Director General Viktor Komardin. “Together with the Indian specialists, Russia is ready to design a new submarine in accordance with the Indian Navy’s requirements as well as transfer the necessary technologies to its strategic partner and assist in the construction of the submarines at Indian shipyards” - he stressed.
MODERNISATION of Russian Submarines

CDB ME Rubin and the Admiralty Shipyards are providing all set of services for development, operation and maintenance of submarines. Easy and reliable operation, powerful armament, high quality construction and low noise level attracts the customers

As is known, India is a strategic partner of Russia and one of the major customers of Russian equipment for the Navy. Cooperation with India in the field of underwater shipbuilding, beginning from the late 1960s when the first torpedo submarine of 641 Project was supplied to the Indian Navy, is continuously developing and as of today covers all spheres: from deliveries of final products by them nowadays to remain a rather competitive product. Success of this Project including today’s success is due first of all to multiyear fruitful interaction between designer and shipbuilder. Designer is CDB ME Rubin, the biggest Russian design bureau founded in 1901 who was capable to implement in the Project all the most positive features of earlier developed diesel-electric submarines. Shipbuilder is Open Joint-Stock Company the Admiralty Shipyards.

The ammunition may include 8 missiles, thus two successive four-missile salvos can be provided. The sensors are also considerably renewed. New sonar complex, periscope complex with optronic mast having infrared and TV cameras and radio communication complex with towed cable radio antenna are fitted.

New-generation submarine Amur-1650 of smaller displacement compared to Kilo class submarines. The sonar complex includes a passive antenna unique by sizes and characteristics and capable of detecting even a very low-noise submarine at a long distance.

CDB ME Rubin has also developed the Amur 950 Project, where the missile compartment of weapon is of priority. The submarine has 10 universal vertical launchers for any type of cruise missiles of Club-S complex. Thus, ten-missile salvo with interval between launches from 5 to 7 seconds is ensured.

Integrated combat control system with up-to-the-minute sensors and electronic subsystems makes it possible to solve all tactical tasks and effectively use missile and torpedo armament.

Foreign customers are attracted by easy and reliable operation, powerful armament, and high quality of construction as well as low noise level of submarines designed and constructed in Russia. At the same time, at customer’s request, submarines can be outfitted with equipment produced by the customer and third countries.

At present, CDB ME Rubin and the Admiralty Shipyards are able to provide all set of services for development, operation and maintenance of submarines. They acquired broad experience from interaction with customers in training of personnel and engineers, and after-sale service of supplied submarines including supply of spare parts, conduct of maintenance and repair works.

Russia to joint developments of equipment/documentation, and activities in repair and modification of Russian-made submarines by Indian shipyards. Taking into account a wide range of interests of Indian customer and industry, CDB ME Rubin’s booth at DEFEXPO 2010 displays Kilo class submarines – the basis of Russian export submarines in the late 20th - early 21st centuries as well as promising submarines from the Amur family (Amur-1650, Amur 950).

The unique feature of Kilo class submarines (Projects 877EKM and 636) is their considerable modernization potential allowing for effective interaction between designer and shipbuilder. The configuration is that Amur-1650 can take onboard and use weapons in any combination and carry out salvo firings (up to 6 missiles in a salvo).

Amur-1650 is a low-noise submarine. Its noise level is reduced by two times compared to Kilo class submarines due to the use of ship’s machinery with low vibration specially developed for these submarines. Amur-1650 submarine integration level and capabilities of sensors are better compared to Kilo class submarines. The sonar complex includes a passive antenna unique by sizes and characteristics and capable of detecting even a very low-noise submarine at a long distance.

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Practically all surface combatants and submarines of the Russian Navy are fitted with radio-electronic systems and devices developed by Concern Granit-Electron JSC. Presently designed and manufactured surface combatant, submarines and coastal missile systems widely employ radio-electronic integrated systems developed by JSC Concern GRANIT-ELECTRON.

JSC Concern GRANIT-ELECTRON incorporating a number of leading defense manufacturers and possessing branches and testing fields was founded to implement perspective research programs of developing ship-borne radio-electronic armaments. Concern currently unites: Severnyi Press JSC – manufacturer of anti-ship cruise missiles’ homing heads and control systems, Plant named after .Kulakov JSC – producer of ship-borne weapon control and self-defense systems, Ravenstvo JSC – developer of radio-technical systems for different launchers, Saratov radio sets-producing plant – manufacturer of coastal and ship-borne radars, Ravenstvo-Service JSC specializes on launching and adjustment works and service support. The highest level and competitiveness are ensured by the use of the unique technologies and advanced achievements of radio techniques, computer facilities and functional SHF-microelectronics, highly effective means of display and multi-stage tests.

It is important to mention that Concern delivers for export the most advanced serially-tested radio-electronic systems with application of the brand-new developments. Within recent 15 years the Concern supplied dozens of different complexes, systems, devices and equipment to India, Vietnam, Algeria, Indonesia, China. Those systems feature highest operational qualities and reliability, meet most advanced international standards. The Concern trains specialists from different countries to operate and arrange service support to earlier delivered equipment. Granit-Electron ensures guarantee and post-guarantee repair and maintenance within the whole life cycle.

In order to improve efficiency and quality of post-guarantee service support the Concern became a co-founder of joint Russian-Indian enterprise Rooboronservice India Ltd.

JSC Concern GRANIT-ELECTRON supplies 3Ts-25E ship-borne target designation radar, ship-borne automated fire control systems for the Uran-E, Yakhont, BrahMos anti-ship missiles and the Purga torpedo and bomb fire control system. For submarines Concern Granit-Electron JSC also supplies KRM-66E integrated radar system (IRS) and other equipment. For missile systems the Concern produces onboard control systems including homing heads for the Yakhont supersonic cruise missiles.

Accumulated scientific-technical potential ensures strengthening positions of Granit-Electron in occupies segment of the market. The Concern conducts a significant volume of works to improve technical characteristics and reliability of the equipment in such directions as:

- Universal detection and homing system
- Universal onboard control system
- Simulation and testing equipment for complicated systems
- Receiving and processing signals systems with the perspective elements basis application
- Methods and algorithms of intellectual control over complicated technical objects
- Systems implementing multi-position radio location principles
- Jam-resistant systems for information exchange
- Distributed interactive technology of simulation and training for complicated radio-electronic systems

JSC Concern GRANIT-ELECTRON concentrates scientific-production potential of daughter enterprises with the purpose of maximum unification of manufactured products, reduction of costs and expenses saving which increases competitiveness on the international markets.

The Concern Granit-Electron JSC enterprises conduct a significant volume of works in cooperation with partners and customers to improve quality of supplied systems. We are ready to develop cooperation in major directions of our activity. The advertorial is based on the article by Georgiy A. Korzhavin, Doctor of technical sciences, Honoured designer of the Russian Federation.

3, Gospitalnaya str., St.Petersburg 191014, Russia
Tel. +7-812-2714585, Fax:+7-812-2746339
E-mail: cri-granit@peterlink.ru
www.granit-electron.ru

Mr. Georgiy A. Korzhavin, General Director of Concern Granit-Electron JSC
Integrated Bridge Systems for Surface Combatants

Application of information technologies is considered to be a perspective direction in development of automation facilities for control processes on the up-to-date naval surface ships. Improvement of information technologies and extension of their capabilities enabled to start development of the functionally united integrated bridge systems (IBS) and integrated control systems of technical facilities.

Nowadays there is a necessity to develop future integrated bridge complexes, which unite integrated bridge systems and motion control systems of surface ships. Their implementation significantly increases the efficiency of ship’s control in general.

The Concern AVRORA Scientific and Production Association JSC is involved into the development of integrated bridge systems, which automate operation of bridge command position crew of a ship.

The task of development of integrated bridge complexes is solved by automation of all the ship processes due to creation of a distributed hierarchical control system with IBS on the top of it.

IBS combines navigation system, automatic radar course plotting system, autopilot, control consoles of power generation plant, thrusters, loading and unloading facilities and communication systems. Creation of a unified information network opens up possibilities to improve operational characteristics of an integrated system.

Integrated bridge systems include automated workstations of the main crew officers of a surface ship. They ensure automation of activities of a bridge command position crew.

- Commander of a ship (AWS-C);
- Watch officer (AWS-WO);
- Pilot (AWS-P).

The functions of IBS are determined by the tasks being fulfilled by the crew of a bridge command position:

- Monitoring of sea situation;
- Navigation safety;
- Ship course and speed control;
- Monitoring of ship’s technical facilities and weapons;
- Ensuring of all types of communications;
- Control of ship’s crew activities;
- Organization of all kinds of ship security and defense;
- Organization of underwater anti-sabotage defense at moorings;

IBS is based on integration of equipment at the level of its functionality, it ensures informational and technical interfacing with all the ship systems, performing collection, processing and displaying of information on the automated workstations.

At present time the Concern AVRORA Scientific and Production Association JSC is developing the integrated bridge systems for a number of surface ships being built in Russia.

During development of a ship’s cartographic server for a foreign customer, the Concern has created a new scientific and technical foundation for interaction of customers who use electronic navigation charts.

The Concern AVRORA Scientific and Production Association JSC was registered at the International Hydrographic Organization and received unique keys to use them in the cartographic server’s software.

The Concern AVRORA Scientific and Production Association JSC displayed a sample of a cartographic server as part of the integrated bridge system for small high-speed ships at the International Maritime Defense Show, which took place in 2009 in Saint-Petersburg, Russia.

Concern AVRORA Scientific and Production Association Join Stock Company 15, Karpyshova Str., St. Petersburg, 194021, Russia Tel: +7-812-297-2311 Fax: +7-812-324-6361, 297-8142 www.avrorasystems.com
40 years of Successful Cooperation

By Rajiv Kumar

The Severnoye Design Bureau JSC being Russia’s leading designer of destroyers, frigates, corvettes and boats has been successfully solving tasks of military-technical cooperation with Republic of India for four decades now.

The cooperation was triggered in 1975 by a contract for building Project 61ME frigates at the Soviet Union’s shipyards. The lead ship of a 5-unit series (frigate Rajpur) was handed over to the Indian Navy in 1980. Delivery was followed by a number of joint projects.

In the end of last Century three frigates of pr.11356 also designed by the Severnoye Design Bureau specialists were handed over to the Indian Navy.

The chief feature of the export frigate lies in its suite of armaments. This is the world’s first warship armed with a Club-N strike anti-ship system firing 3M-54E missiles (with firing range is up to 220 km) fitted with a supersonic warhead discharged at the final stage of the flight.

The project was such a success that Republic of India following results of ships’ operation by the Navy ordered manufacture of another three frigates in Russia. The construction of second series of frigates is carried out at the Kaliningrad-based Yantar Shipyard. But these ships are not complete analogues of the first three. The major difference is availability of the BRAHMOS strike missile system. The system is based on the supersonic anti-ship missile jointly developed by Russia’s NPO Mashinostroenia and DRDO of the Indian Defense Ministry.

BRAHMOS missile features speed of up to M 2.8 and maximum flight range of ab.300 km. At the final leg [at approach to target] flight elevation is 5 m which makes it practically invulnerable to opponent’s countermeasures.

High modernizing potential of the frigate enables to offer a new version of the ship within short terms which will not require serious changes in design but will feature more extended combat capabilities first of all in the part of air defense.

The Severnoye Design Bureau is working on the upgraded project of frigate which will feature replacement of the Shtil surface-to-air missile system with the Shtil-1 vertical launcher.

Shtil-1 multi-channel SAM system developed by ALTAIR

Naval Radio Electronics Research Institute is intended to conduct round defense of ships against any air attacks in particular to repulse massive missile and aerial attacks, as well as to deliver strikes at surface targets.

The system’s composition can include one or several launchers with missiles, fire control system. The system operates interacting with the ship’s 3D radar. The composition of the system offered for installation on the future frigates includes 2 combat modules with 24 missiles.

Such a composition enables to ensure round defense of the ship (sector of fire of 360 deg.), as well as rate of fire of 30 launches per minute as launch of the first missile can be immediately followed by the start of the second one.

Thus installation of the system significantly increases defensive capabilities of the ship in comparison with a previous modification with the Shtil SAM system featuring inclined-type launcher.

In addition to a new SAM missile system the Duet AK-630-M2 close-in self-defense system is offered for installation. At customer’s request the second three frigates were equipped with two AK-630 artillery mounts. Duets enable to double density of fire in comparison with AK-630 – their rate of fire is up to 1000 rounds per minute. Availability of two barrels is not the only difference of Duet, it features new shapes of turret and barrels’ jacket. Visible over-deck part of the gun is made of up-to-date radio-absorbing materials which significantly improves characteristics of secondary radar field.

New capabilities of advanced radio-electronic armament systems being considered in the process of ship’s modernization enable to improve depth of integration of the weapon control aimed at increase of efficiency of ship’s combat employment.

Recently a new law was adopted in Republic of India which allows Indian private companies to design and produce defense products in the interests of national Armed Forces. The law allows the companies to attract on tender basis foreign designers of defense equipment.

Enlisting of new highly technological enterprises to the implementation of the Naval Forces’ orders seems to be a justified measure given the necessity to reduce construction terms. It is not excluded that it can open new opportunities for participation of Russian companies in the programs of the Indian Navy for example in the manufacture of new future ships on Russian design at Indian shipyards with application of advanced technologies of all-the-year-round construction. Technical equipment of new shipyards helps considering such a prospect with optimism.
2012 is to become a remarkable year for the Indian Navy when a modern beautiful powerful ship- the Vikramaditya aircraft carrier has been scheduled to leave Russia for India to become the Republic’s strongest vessel. The 280m carrier is going to deck 21 Russian-made MiG-29K shipborne fighters plus 13 naval helicopters. The carrier is to become the national pride and power symbol as a blue waters “pen of politics”.

Nowadays Vikramaditya has been refurbished at the Sevmash shipyard based at the Russia’s European north coast at Severodvinsk. The leader of the Russia’s national shipbuilding was assigned for the job to transfer the ex-Soviet Admiral Gorshkov cruiser into an Indian aircraft carrier in 2004 after ten years inter-state negotiations. According to the press reports, in January 2004 the Indian Navy and Rosoboronexport concluded USD 1.5 bn. deal. Almost a half of the sum was supposed to be spent on the ship’s refurbishment while the rest was for the shipborne aviation group. Later on the contract terms and value should have been revised due to the obvious reasons. It turned out that the Sevmash shipbuilders were not going just to upgrade the ship but to fit the hull with the latest technologies, systems and equipment. The hull itself should have been also improved with the flight deck extension till 283 m up to the bow for springboard installation. Apart of that, Admiral Gorshkov is to be equipped with three cable-type arresting gears to shorten the docking MiG-29K fighters’ run. The ship must be also fitted with two lifts with 20 and 30 t payload to bring the aircraft from the bottom deck to the upper one. Hangar and stern lift dimensions are to be extended. The optical aircraft docking system is to be installed too. The ship’s armament must be also improved. Vikramaditya is to receive the latest electronic systems including navigation, radar, C4I. So, the ship is to leave the Russian shipbuilding’ harbor will be a brand new one.

Right now the aircraft carrier is in a high stage of readiness. The Sevmash works and materials quality has always been accepted by the Indian monitors group constantly presenting at the shipyard’s facilities. The shipbuilders’ skills have been confirmed through the long standing experience with the Russian Navy in powerful nuclear submarines to form up Russia’s national nuclear shield. But the Sevmash personnel are ready to react on new requirements from the Indian side. Vikramaditya has become a launching ground for various innovations in production process. The Sevmash engineers were decorated with the new national scientific award - the Lomonosov state prize.

Aircraft carrier upgrade and repair is the most complicated project. Sevmash have contracted over hundred of enterprises to obtain dozens of tons of rolled steel, thousands units of equipment and parts. The ship’ hull employs up to 2000 people daily plus 3000 at the shops and offices.

According to many experts Sevmash created a solid basement for advanced aircraft carrier’ shipbuilding.

At the same time the politicians are busy with the contract’s value negotiation. The deal is close to conclusion with a compromised price to satisfy both sides. But what will be afterwards?

Will the first Russian-Indian carrier remain the one and the only? Should India put an eye on the other nations able to build such ships? The answer on all those questions was given during the recent India-Russia presidential summit at Moscow. Mamnoon Singh and Dmitry Medvedev concluded several contracts on defense and energy co-operation to make a sign of satisfaction on various subjects including the aircraft carrier deal. It is also a sign that India is not going to try “stranger” partners in such a tentative sphere.

Sevmash time-proven quality as well as shipyard’s capacity enables to build large dockships, nuclear and conventional submarines, logistics and transport ships. What is also important, the Russian enterprise has enough experience to build various oil and gas offshore constructions to participate in Russian-Indian cooperation in this sphere.

Cooperation with Sevmash could become a very profitable strategic move for our nation. The Russian shipbuilders’ participation with the Indian shipyards upgrade is to bring a strong input into the national shipyards’ development.

As for the aircraft carriers, Sevmash seems to be the best possible option for India.
The term ‘Littoral’ is derived from the Latin litora, meaning ‘shore’. Littoral zones are areas that extend from the high water mark to shallow areas. Due to the movement of water, typical landforms like sand dunes and estuaries are made. In military naval terms, ‘Littoral Warfare’ is the warfare in littoral zones including surveillance, mine-clearance and support for landing operations. Littoral warfare thus involves landward as well as seaward elements of the battle space. Likewise, missions for the navy could range from forward positioning of forces to control an adversary that will challenge the navy in the naval expeditionary forces for power projection. Littoral warfare thus requires specially designed ships and adoption of new technologies to support the changed battle environment. Countries, like the US and UK, are already adapting to the changed strategic naval environment. The Royal marines have received a new troopship/landing craft HMSC Ocean. Plans are afoot for new helicopters, drones, etc. The US Navy is planning to provide accurate fire power to the next generation of destroyers for supporting ground troops. Designing of armament systems is underway and these are going to be purely cruise missile carriers to support ground operations. Littoral warfare may involve conducting non-traditional military missions like humanitarian assistance, disaster relief, counter-terrorism and operations for political stability. The flexibility of the US perspective, most of the areas of instability and social strife are in major cities and urban areas, which are easily accessible to the navy. The littoral environment is less than 60 per cent of the critical significantly urban areas the world are located within 40 km of the coastline and 70 per cent are located within 240 km of it. The military actions required to protect the interests of the US in the region, will mostly come from the sea, and thus it is necessary for the US Navy to operate in the littorals. The other aspect is due to financial constraints and political opposition, it will not be possible for the US to maintain the US bases in every potential area of interest. Under such circumstances, a littoral enabled force will be of immense help.

Equipment & Force Structure

Air Defence: The air threat will include tactical ballistic and cruise missiles. Stealth technology will reduce the radar cross-section of aircraft and missiles. The land clutter and reduced reaction time in the littoral environment increases the problems for existing navy early warning, tracking and targeting systems, which were designed for the sea. Thus, effective AD of the fleet and the troops ashore, which can operate in the littoral environment will be of great importance for the success of the operation.

Anti-Surface Warfare (ASUW): The aircraft carrier continues to play a central role in ASUW operations for the navy. It is because of its ability to provide the littoral forces with the time and place of our choice, destroying or interdicting enemy ground forces and infrastructure, and providing close-air support for expeditionary forces during amphibious operations. There may be fewer carriers in the future, which imply that smaller surface combatants should be able to operate independently from the carrier and carry out similar, but limited role. These surface combatants must have the capability to carry helicopters and weapon systems to counter threat of small craft.

Submarine Warfare: Submarines can influence the littoral environment by conducting strikes against land-based targets with Tomahawk cruise missiles. Submarines can also be used to conduct covert surveillance and induction/de-induction of the Special Forces against the enemy close to shore. The ability to conduct shallow-water (<200 feet) ASW is essential to littoral warfare. As the LCS will be a system designed for littoral warfare, a few sonar systems and weapons with shallow water capability will have to be acquired.

Ambush warfare: Ambush warfare plays an essential role in projecting sustainable combat power ashore. Successful ambush operation will be networked to share tactical information with other naval aircraft, ships, subma suspicious and various types of mine.

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LCS USS Freedom (LCS 1), the first ship in the US Navy’s new Littoral Combat Ship Class. Small boats are critical for littoral missions. They can operate with focused-mission packages that deploy manned and unmanned vehicles to execute the desired missions. The LCS will also be able to undertake Special Operations Forces support, high-speed transit, Maritime Intervention, Intelligence, Surveillance, Reconnaissance, and Anti-Terrorism/Force Protection. While complementing with the capabilities of the US Navy’s large current fleet, the LCS will also be networked to share tactical information with other Navy aircraft, ships, subma suspicious and various types of mine.
jectiles for larger calibre (127 mm, 155 mm and even larger) guns. The ERGM projectile, with a range of up to 110 km, and inbuilt GPS and INS, are expected to be available within the next decade. The 155 mm shells with additional rocket motor drive and inbuilt intelligence and autopilot development are expected to provide maximum ranges of up to 320 km.

Persistent close-in weapon system (CIWS) Guns (General Dynamics now Raytheon, US): The Phalanx is an anti-ship missile system consisting of a radar-guided 20 mm. Gatling gun mounted on a swiveling base. The Phalanx is used by the US on every class of surface combat ship.

Electro-Magnetic (EM) Rail Gun: This concept uses kinetic energy to extend the range in an affordable manner. An EM rail gun uses a combination of pulsed power system and linear accelerator to accelerate projectiles to hypersonic velocities. Experiments have demonstrated that the projectiles could be accelerated to achieve a speed up to 2.5 km per second and it is possible to achieve hypersonic velocities of up to 6 km per second.

Directed Energy Weapons (DEW) Technology developments in future generation anti-ship missiles will make it very difficult for countering them with conventional threats. Thus the role of DEW has greater importance.

As an example, compact DEWs mounted on aircraft or remote vehicles can be used to severely degrade an adversary’s electronics, surveillance and C3 capabilities. Incoming missile threats can either be severely degraded or even destroyed. The technology areas for DEW include the following:

- **Laser Weapons:** In the next decade laser weapons are expected to be deployed on board naval surface ships as CIWS. High-energy lasers are already under advanced stages of development in the USA, China, Russia and Israel.

- **High-power Microwave Weapons:** Unlike directed energy laser weapons that physically destroy the target, HPM weapons use high-power electromagnetic energy to disrupt the performance of electronics in computer, communication and electronic systems.

Air Armament

The Indian Navy has the Sea Harrier FRS 51 and Mig-29K in the process of being inducted. The Fighters normally have guns and carry bombs, rockets and missiles. Missiles can be air to air and air surface. Some of them are:

- **Guns:** ADEN 30 mm which is fitted on the Sea Harrier has a muzzle velocity of about 7400 m/s and rate of fire 1000-1700 rpm. Mk32 has 30mm Gryazev/Shipunov GSPh 301 (TKB-607/84/G67/1K) single barrel gun with 155 AO-18 rounds.

- **Bombs:** Fighters can carry a variety of bombs of many sizes and types, like free fall, cluster, fuel air explosive, runway denial and TV guided. KAB-500KG is a TV-guided HE bomb and the KAB-500DD a fuel-air bomb. Both are of Russian origin and can be fitted on MK-29.

- **Rockets:** Rockets can be guided/unguided and of many types: the Matra rocket pods of French origin with 16x SNEB 68 mm rockets, each fitted on Sea Harrier or 240mm S-24B heavy unguided rockets (up to six) of Russian origin which could be fitted on MiG-29K.

- **Missiles:**
  - AIM-9 Sidewinder is of US origin, R homing with a range of 1-18 km.
  - AIM-7 Sparrow of Raytheon, AIM-120 AMRAAM is of US origin and is beyond visual range capability with a range of 48 to 208 km. It can be fitted on a variety of aircraft including F-22 and Tejas.
  - R550 Magic is of French origin with a range of 0.3 km to 10 km.
  - R-77 TV-AE air-to-air missile is of Russian origin with a range of 5km to 25 km.

- **Air-to-surface missile**
  - The AGM-88 High-speed Anti-Radiation

- **Anti-submarine**
  - The APR-3E airborne light ASW acoustic homing torpedo of Russian origin is designed to engage current and future submarine at depth from the surface down to 800 m at a speed of up to 43+ knots. It can be carried by various fixed wing and rotary wing aircraft and has a range of more than 2 km.
  - SSN Zagam is a guided but unspurred depth charge which is launched from a fixed wing or rotary wing platform. The sonar mounted in the nose of the depth charge is then activated and starts searching for hostile submarine and guides depth charges toward the target. It has a sonar lock-on radius of 120 m.

**Underwater weapons**

Underwater weapons are predominantly used by submarines which are normally armed with torpedoes and mines. In addition, the submarines carry decoys for evasion against torpedoes attack by enemy warships and submarines. In the mid-1970s, submarines began to be armed with anti-ship and later with land attack missile. Of all these weapons, the torpedo is indisputably the most complete and lethal weapon. A modern torpedo is capable of destroying targets over 40 km away closing in at a speed of about 50 knots. It has enormous processing power and is intelligent enough to guide a specific target or reject a decoy. Torpedoes form about 80 per cent of the weaponry of a submarine and the components used in a torpedo are largely representative of the components used in almost all underwater weapons. Some examples are:

- **Mark 46:** The Mk46 “Mk46” Lightweight Torpedo integrates the existing torpedo hardware and software from the Mk46, Mk50 and Mk48 torpedo programmes with state-of-the-art commercial-off-the-shelf digital signal-processing technology. It is propelled by liquid propellant and its contractor is Raytheon.
- **Mark 48 and its upgrades:** Mark48 and its improved ADCAP (Advanced Capability) variant are heavyweight submarine-launched torpedoes of the US origin. The Mk48 Mod 7 Common Broadband Advanced Sonar System (CBASS) torpedo is optimised for both the deep and littoral waters and has advanced countermeasure capabilities. The Mk48 ADCAP Mod 7 (CBASS) is the result of a joint Development Programme with the Royal Australian Navy.
- **Type 53 torpedo:** This is the common name for a family of 53 cm torpedoes manufactured in Russia, starting with the 53-37 torpedo and continuing to the modern UGST. With the exception of the UGST which uses Mark 48 style monopropellants, Soviet 53 cm torpedoes generally use electric power, or kerosene mixed with various oxidisers for propulsion. Its range varies from 18 to 22 km and has a speed of about 45 knots.

**Missile (HARM) is of the US origin, manufactured by Raytheon and has a range of 106 km.**

- **The Matra is an Anglo-French anti-radiation missile with a range of 60 km.**

**Anti submarine**

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Unmanned Aerial Vehicles are deployed to undertake functions of Intelligence-Surveillance-Reconnaissance, and target, strike and combat support roles both from on-shore and naval platforms.

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During the last decade of the twentieth century, the Unmanned Aerial Vehicles (UAVs) have emerged as a versatile platform to undertake multi-faceted role in support of land based, aerial and naval operations. Consequent upon the significant contribution made by UAVs such as the Predator, Hunter and Pioneer in the Gulf Wars, Kosovo, Bosnia, Iraq and Afghanistan lead to its recognition as a force multiplier. The UAVs are designed to provide real time imagery through reconnaissance, surveillance, intelligence gathering and targeting by using a combination of infrared/optical sensor and a laser target designator, and now the weapon delivery platform as well. The UAVs combine the advantages of aerial platforms such as speed, flexibility and reach with those of unmanned platforms such as lower cost and higher risk employability, providing enormous operational flexibility. With its aerodynamic design, it provides significant advantage in terms of endurance and extended operational time on tasks, as opposed to manned aircraft. In classic sense, the UAVs are being deployed to undertake roles of Intelligence-Surveillance-Reconnaissance (ISR), and target, strike and combat support roles both from on-shore and naval platforms. Various types of UAVs like mini, micro, small, vertical take off and landing (VTUAV), medium altitude endurance (MALE), high altitude endurance (HAELE) and unmanned combat air vehicles (UCAV) are ideally suited for naval operations.

The US Navy has embarked upon the UAV programme in a big way with the introduction of Global Hawk, from General Atomics of US as part of the Broad Area Maritime Surveillance Project (BAMS) for Maritime Reconnaissance (MR) duties. The German Navy is inducting Euro Hawk which is another variant of Global Hawk as a replacement for Atlantique, MR aircraft. The Israeli Navy has launched its IAI-Heron as a replacement of IAI Westwind, MR aircraft. Increasing significance of UAVs in long endurance shore based surveillance role, has highlighted the essentially of inducting UAV as an organic surveillance capability for ship borne operations. This concept has given birth to rotary UAVs equipped with surveillance and classification sensors. In concretising this concept, the notable programmes underway are Fire Scout of Northrop Grumman, Orca of Boeing, Camcopter of Scheibel and Eagle Eye of Bell. These UAVs have longer endurance than manned helicopters, as is the case of the Boeing's Hummingbird, in the region of 24 hours, far in excess to the performance of fixed wing UAVs.

VTUAV

Since VTUAV is capable of ship borne operations, it can provide real time imagery data to support intelligence, surveillance and reconnaissance for operations, both from ashore and at sea. It can also reduce sensor to shooter reaction time and can extend its capabilities to other mission areas. The US Navy has chosen the RQ-8A Fire Scout as its vertical VTUAV. Northrop Grumman-Ryan Aeronautics of San Diego was awarded an engineering and manufacturing development contract for the Fire Scout, which would provide situational awareness and precision targeting support to the US Navy and Marine Corps. In August 2005, Fire Scout was upgraded from RQ-8 to MQ-8B configuration to its role capability, including the weapons delivery. Fire Scout has the capability to be launched and recovered from any warship fitted out for helicopter operations, as also from sparsely prepared landing zones close to the forward edge of the battle area (FEBA). It can carry out surveillance, find tactical targets, track and designate target platforms and provide accurate targeting data to strike platforms such as strike aircraft, helicopters and ships. The MQ-8B has four rotor blades, increased payload capability of 270 kg and endurance in excess to eight hours with a payload of 90 kg. Encouraged by the successful upgrade of MQ-8B Fire Scout, the USN is being induced to the new Littoral Combat Ships (LCS). Baseline payload for the USN includes the FLIR Systems AN/AQY-23D BriteStar II target designation system with electro-optical and infrared sensors and a laser range finder/designator. Northrop Grumman is also carrying out a weapons integration programme which includes the installation of two four-packs of 2.75in rocket launchers.

Intelligence Gathering

Historically, intelligence gathering aerial platforms have always had to operate at a distance from their intended intelligence sources for fear of retribution. This limitation has resulted in reduction of capability to intercept low signal strengths or gain intelligence inputs available only close to the source. This capability of the UAVs to perform this vital role has changed the scenario drastically. The UAVs are able to penetrate deeper and therefore closer to the intended targets both because of its low detection probability as well as acceptance of greater risk in its deployment.

Defensive Operations

With growing potential of UAVs, there is ever increasing endeavour towards developing larger platforms with enhanced payloads to integrate both sensors and weapons. The arms competition programme for UAVs was launched with MQ-1 Predator carrying eight (50 kg) Hellfire missiles. This initiative has worked wonders in both Iraq and Afghanistan. The General Atomics have now upgraded the 1 ton MQ-1 Predator to the 5 ton MQ-9 Reaper. Likewise, IAI has developed the Heron TP in the 5 ton class and BAES has commenced development of the 6 ton Mantis. Each of these platforms will have the ability to carry ordnance in excess of 1 ton. In addition to sensor payloads, another notable development on the ‘combat’ UAV front is the jet propelled Unmanned Combat Air Vehicles (UCAVs) which would, in not too distant a future, acquire offensive capabilities similar to that of a manned fighter aircraft. A number of such programmes are currently underway to encompass stealth offensive features into the max AUW category of up to 20 tonnes. For instance, Northrop Grumman X-47B or UCAS-D for
the US Navy will be a carrier borne UCAV. The General Atomics’ Avenger, BAES’ Taranis, Dassault’s nEUROn and MiG’s Skat, are the other prominent development programmes.

Support Operations
By design, UAVs are ideally suited to undertake combat support roles, such as Over-the-Horizon-Targeting (OTHT), Battle Damage Assessment, Electronic Attack, Decoying and Communication Relay, Airborne Early Warning (AEW) missions, etc. Current developments in this field are being steered towards developing UAVs that carry only the AEW receivers which being passive, can be positioned close to the war-zone even as the transmitter is retained on a manned platform at stand-off ranges. This manned-unmanned combination for AEW is expected to significantly increase the aerial target detection ranges. As UAVs fly much slower than currently available aerial refuelling aircraft, they cannot be re-fuelled in the air. UAVs capable of mid air refuelling are currently under development to overcome this deficiency.

IAI’s Heron MALE UAV
Heron is capable of MALE operations of up to 52 hours’ duration at an altitude of 35,000 ft. Its latest version is designated as Heron TP. It is in service with the Israeli Defence Forces apart from India and Turkey. Heron navigates using an internal GPS receiver or with a pre-programmed flight plan. It can autonomously return to the base and land in case of breakdown in communication with the ground station. The system is all-weather and has fully automatic launch and recovery capability. Heron can carry an array of sensors, including infra-red and visible-light surveillance, intelligence systems and various radar systems up to a maximum weight of 250 kg. Heron is also capable of target acquisition and weapon delivery-adjustments.

IAI’s Searcher Mk II
Searcher Mk II is a multi-mission tactical UAV system used for surveillance, reconnaissance, target acquisition, weapon delivery adjustment and damage assessment. The Searcher Mk II has multiple operational configurations to include SAR/GMTI, SIGINT and EO/IR; reduced radar detection, operations in adverse weather conditions, automatic launch and recovery system and state-of-the-art avionics. Its payloads include electro Optical (TV & IR Combination or Triple Sensor TV/IR/LD), Synthetic Aperture Radar, COMINT & ESM Integration Capability and can also integrate customer furnished payloads. It has an endurance of 20 hours, a range of 300 km, and can operate at an altitude of 23,000 ft with a payload of 120 kg.

Conclusion
Force-multiplier capability of UAVs stand fully established with the potential of enormous tactical advantages. Global recognition of the latest in unmanned technologies as the future of war-fighting is now complete. The Indian Navy (IN) acquired the pioneering status when UAVs were inducted in its inventory in 2002. Time is now opportune for the IN to consider induction of ship borne VTUAVs for not only cost effective maritime domination solutions, but also other engagements, both offensive and support operations such as — targeting, intelligence gathering, search and rescue, target acquisition and engagement, anti-piracy and real-time battle damage assessment. MALE type of UAVs is the ideal platform for carrying a tactical control system for conducting operations for battle space domination. The successful development of UAVs, the future UAVs, has added an exciting and revolutionary dimension to the maritime domain.
In the year 1774, a small dry dock was constructed in the Mazagon Wharf, Mumbai, to service ships of the British East India Company. The company was named Mazagon Dock. Over the next 200 years, the dry dock progressively developed into a massive conglomerate, universally known as the Mazagon Dock Limited. At present, it is the leading warship-building yard in the country and one of the most heavily loaded, producing sophisticated world-class warships and other commercial craft.

Important events during the year 2008-09
- Keel Laying of Two Multipurpose Support Vessels (MSVs) being built for Ms. Greatship Global Offshore Services Pvt. Ltd, Singapore on July 14, 2008.
- Commencement of New Wet Basin work on September 10, 2008 as part of Mazdock Modernisation Project.

Financial highlights
- The Value of Production for the Financial Year 2008-09 as Rs 2568.93 crore ($507.99 million) as against Rs 2321.69 crore ($450.29 million) in the previous year.
- The profit is Rs 297.28 crore ($61.29 million) for 2008-09 as against Rs 380.70 crore ($78.69 million) in the previous year.
- Capital Structure: The Authorised Equity Share Capital and Preference Share Capital of the Company as on March 31, 2009 stood at Rs 1500.00 crore ($318.64 million) and Rs 123.72 crore ($26.86 million) respectively.
- The Paid-Up Equity Share Capital as on March 31, 2009 remained at Rs 199.20 crore ($43.26 million) and that of the Preference Share Capital was at Rs 49.49 crore ($10.74 million), after redemption of second installment of Rs 24.75 crore ($53.37 million). There was no increase in the Authorised or Paid up Equity Share Capital during the year.
- Dividends: Taking into consideration the distributable profits after the third installment of Rs 24.75 crore ($53.37 million), for the redemption of the Preference Share Capital due in 2009-10, the Board of Directors recommended for a dividend at 25 per cent on the Equity Share Capital arrears to Rs 49.80 crore ($10.81 million) for the year 2008-09.
- Contribution to central exchequer: MDL’s contribution to the Central Exchequer through Income Tax, Service Tax, Custom Duty, Excise Duty, F.B.T. and dividend with associated taxes, during the year 2008-09, was Rs 280.21 crore ($60.86 million).

Division-wise Performance

Shipbuilding: The Shipbuilding Division achieved a Value of Production of Rs1421.85 crore ($307.25 million) during the year 2008-09, as against Rs 1609.30 crore ($343.08 million) during the previous year and against Rs 2085.37 crore ($450.6 million) of the Budget Estimate for the year 2008-09. Submarines: The Value of Production on account of Submarine construction and repairs was Rs 1146.43 crore ($247.72 million) during the year 2008-09, as compared to Rs 659.13 crore ($142.42 million) the previous year. This was against Rs 914.63 crore ($197.63 million) for the financial year 2008-09. Augmentation of necessary facilities is progressing at a satisfactory pace.

Future outlook:

- ASW Corvette class of warships with stealth features for Anti-Submarine Warfare role for IN (four ships). The first ship is slated to be launched by April 2010.
- High speed, Fast Attack Crafts (FACs) with water Jet Propulsion for Indian Navy (six ships).
- Inshore Patrol Vessels (IPVs) for ICG (eight ships).
- Fast Interceptor Boats (FIB) of 12 ton and 5 ton capacity, for coastal security (86 crafts) by the Ministry of Home Affairs.

The shipyard has also undertaken major repair work of a warship of Indian Navy and another warship of a friendly country. Besides designing and building warships, the company also manufactures diverse range of engineering equipment like various types of Bailey Bridges, Suspension type Bridges, Centrifugal & Turbine Pumps, Helicopter Traversing Systems, Hydraulic Bow Davit, Capstans, Anchor Windlass and Assembly, and also conducts tests & repair of various types of diesel engines used for marine propulsion/power generation, under license from MTU, Germany.

During the FY (2008-09), GRSE has scaled many new heights, setting several new records in performance. The important accomplishments during the year 2008-09 include:
- The delivery of seven ships in a financial year, and thereby setting the record of highest number of ships delivered in a year. The following ships were delivered during 2008-09:
  - INS Arvad, the last of the series of Landing Ship Tank (Large) to IN.
  - INS Car Nicobar and INS Chhetri, the first two ships of the series of ten Water Jet Fast Attack Crafts to IN.
  - MV Lapatyi & MV North Bay – 65 passenger-cum-vehicle ferries (RO-RO vessels) to Andaman & Nicobar Administration.

- MV Afra Bay & MV Karmatang – 100 passenger-cum-cum-vehicle ferries (RO-RO vessels) to Andaman & Nicobar Administration.
- MV Antelope – 1000/ 520/ 250T Crane, Cradle Assembly Shop and Stores.

The additional infrastructure development required for the submarine construction programme was commenced by augmenting the existing three workshops in Alcock Yard. A new Submarine Assembly Workshop with 200/50T Electric Overhead Transport (EOT) crane facility is planned to be constructed in the Alcock Yard during the period 2009-11. Two new covered store sheds measuring 4000 sq m and 2000 sq m with 10T / 5T EOT Crane facility are also planned to be constructed during the period 2009-10 at Ank Mosque Yard. A submarine berthing facility at Alcock Yard has also been planned. This will effectively result in creation of facilities to handle a second line of submarine construction.

Continued on page 15
For over four decades, Goa Shipyard Limited has designed, built and commissioned a wide range of sophisticated vessels for applications in the defence and commercial sectors with special expertise in building modern patrol vessels of steel and aluminium hull structure.

Established in 1957, the Goa Shipyard Limited (GSL), is a leading ISO 9001-2008 certified shipyard on the West Coast of India, functioning under the administrative control of Ministry of Defence, Government of India. GSL is strategically located on the banks of river Zuari in Goa, a major international tourist destination well connected by its international airport and major port on route all important shipping lanes. Beginning as a small barge building yard, GSL has continuously expanded its production capability into sophisticated ship builders in the country. For over four decades, GSL has designed, built and commissioned the wide range of sophisticated vessels for applications in the defence and commercial sectors with special expertise in building modern patrol vessels of steel and aluminium hull structure.

During 2009, the Company delivered and commissioned two large in house designed 150m Offshore Patrol Vessel (OPV) for the Indian Coast Guard. These vessels are also the largest in the Coast Guard fleet presenting the service with tremendous reach and flexibility during operations. GSL also launched the first large in house designed Naval Vessel with in house design capability for Indian Coast Guard, was commissioned on January 21, 2009 by Antony. The first 105m Naval Offshore Patrol Vessel, built in house design capability for Indian Navy, was launched on March 30, 2009, by Mata Teresa Messias de Andrade de Souza Mehta, the former Chief of the Naval Staff. The production of fourth Naval Offshore Patrol Vessel (H兴建) 1211 has commenced during the year. The construction of first of the 90m Coast Guard OPV Yard 1203 has reached the final stage and the follow up on two Coast Guard OPVs Yards 1204 & 1205 of the 90m series is progressing at Bharuch, Gujarat. The construction of 2nd Sailing Ship (STS) Yard 1210 has commenced during the year. The production of three Harbour tugs for Royal Oman Navy, Sultanate of Oman has also commenced in October, 2009 at sub-contractor's yard. The production of indigenous GRP boats has commenced in December 2008 at GSL Unit-II. Delivery to States of Goa, Gujarat, Karnataka and Maharashtra are expected to commence shortly. The production centres of various states will be trained for operation and maintenance of these boats. GSL teams will be despatched to advise the State and Union Territories marine police on the western coast for creation of infrastructure. The in house infrastructure facilities are also being created at newly acquired premises; at GSL Unit III to enhance manufacturing of the GPR boats.

Ship Repairs
The ship repair activities have been at par with the projected activities like Fabrication, Piping, insulation, electrical cabling, electric/electronic equipment installation and trials, etc. The outsourcing is facilitating the Company to overcome temporary phase of resource constraints due to infrastructure modernisation and to increase production potential of the yard. This has resulted in increasing the capability of the shipyard to meet the commitments made to the customers, fair competition amongst service providers, overall cost reduction, besides meeting the tight delivery schedules of various shipbuilding projects under construction. This initiative has also added to the value of production of the shipyard.

Future Prospects
The Company has been making strenuous efforts to export specially the in-house designed range of Patrol Vessels. The Company in its efforts to seek export orders from abroad for diversified range of products particularly in the Middle East has succeeded in obtaining its first order for supply of three 67 ft. Board Paddle Harbour Tugs for Royal Oman Navy. These are undergoing construction and are expected to be delivered as per contractual schedule.

In response to a Request for Information (RFI) from the Ministry of Defence, Sultanate of Oman, for Patrol Boats for Royal Navy of Oman, the Company submitted the proposal for two variants of Patrol boats and was subsequently cleared to participate in the tender for these Patrol Boats, for which bid has been submitted.

Focus on Sophisticated Vessels

Indigenous Expertise

Ongoing modernisation of hull blocks in a controlled environment.

An integrated facility for blasting and painting activities like Fabrication, Piping, insulation, electrical cabling, electric/electronic equipment installation and trials, etc. The outsourcing is facilitating the Company to overcome temporary phase of resource constraints due to infrastructure modernisation and to increase production potential of the yard. This has resulted in increasing the capability of the shipyard to meet the commitments made to the customers, fair competition amongst service providers, overall cost reduction, besides meeting the tight delivery schedules of various shipbuilding projects under construction. This initiative has also added to the value of production of the shipyard.

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The Indian Navy is looking forward to inducting E-2, the Northrop Grumman’s Advanced Hawkeye E2-D, currently under development in the US.

LIEUTENANT GENERAL (RETD) NAresh CHAND

The operational sequence in an air battle is detection, identification, target designation and destruction. It is inherent in an air battle to be fast moving and reactions are expected within seconds. Tightly detected, identification (friend, foe or stranger) and designation of the target to a suitable weapon system, which may be another aircraft, the SAM system or even a gun system for destruction, is very difficult. The problem is further compounded by the development of aircraft carrier or based sensors (like the radar), due to the antenna height. However, the problem is overcome by raising the antennas height, by placing it on an elevated platform which can be a hill feature, tethered balloon, or an aircraft. Though expensive, an airborne sensor system is the most effective and can cover vast areas of the space. With a suitable crew and battle management system, it can operate as a very effective early warning and control system (AEW and C) system, which is versatile and flexible. It is used both in the navy and the air force. The Indian Air Force has just got its Phalcon Airborne and Warning System, based on a Russian IL76 air craft, which is bound to expand and improve its operational capability. The Indian Navy is holding the ageing Russian TU-142 M and the Kamov Ka-3 helicopter. The navy is looking for a replacement for its TU-142 M. The system can be used as offensive and defensive features.

Naval AEW&G Systems

The US Navy had a global role, and to support it, they developed the carrier borne battle groups which needed sensors capable of detecting incoming air threat in a reasonable time frame. They thus started the development of a radar system in 1944, which could be based on an aircraft capable of operating from an aircraft carrier. The first such system was tried out on a modified TBM Avenger Torpedo Bomber which was a success. It could detect low flying aircraft at a range of about 160 km. It had a long beam, which was improved to an improved AN/APS-20, but they were purely early warning systems with communications capabilities. These advances in airborne radar till 1956, led to the concept of an airborne early warning and control aircraft. The first aircraft to perform this function was the Grumman-E-2 Tracer which was replaced by E-2 Hawkeye. E-2D will replace E-2C. 2000. The original E-2C, known as the Group 0, became operational in 1973 and has undergone many changes since then. The Hawkeye 2000 features the APS-145 radar with a new mission computer and Combat Information Center (CIC) workstations, Advanced Control Indicator Set (ACIS), and carries the US Navy’s new Cooperative Engagement Capability (CEC) data-link system. It is also fitted with a larger capacity vapour cycle avionics cooling system.

Initially, the Indian Navy was offered E-2C, but they wanted the latest version so that it remains operational for a long time. E-2C has been upgraded with eight blade proprotors as part of the NP2000 programme.

E-3 Sentry

Another possible option is the E-3 Sentry which has a naval version, the E-3C with the AN/APS-2 radar (Maritime Track) and other system improvements as well. About nine were built for NATO with no changes in nomenclature. However, other details are not known. E-3 is primarily used by the US Air Force as an Airborne Warning and Control System (AWACS) built on a modified Boeing 707/320 commercial airframe, with a rotating radar dome. Major subsystems in the E-3 are avionic, navigation, communications, sensors (radar and passive detection) and identification tools. As a very short pulse is used to decreases the sea clutter for detection of large and small surface ships in various sea states, it may be possible for any suitable AWACS to be adapted for use as a naval AEW and C system. An adaptive digital processor automatically adjusts to variations in sea clutter and blank signals reflected from land by means of stored maps of land areas.
Network Centric Warfare (NCW), which originated in 1997, is the key concept of the navy to prepare itself for the 21st century warfare by using the advances in information technology (IT) to connect ships, aircraft, and shore installations with a highly integrated network. This would give a quantum leap to the existing naval capabilities and also affect its organisation, tactics and doctrine. NCW will also require to achieve the capability of being able to operate effectively with other friendly navies if the situation so demands.

The Advance IT will include computers, high-speed data links, and networking software to connect the navy with highly integrated computer/telecommunications networks. Ships, aircraft, and shore installations will be able to share immense amount of information at great speed and without any gap. NCW will improve the navy’s combat capability and efficiency by achieving speed in decision making thereby enabling the commanders to take decisions faster than their adversaries and thus defeating them or closing their options. NCW enables the navy to achieve information superiority, has mass effect on the target and prevents the adversaries from carrying out their plans. NCW also enables command, control, communications, computers, and intelligence (C4I) efforts in the navy. The key components of NCW are Cooperative Engagement Capability (CEC) and IT-21 programme (in the US terminology).

A brief detail of NCW is as follows:

**CEC**:
- CEC is a sensor network with integrated fire control that provides a means by which data from existing sensor and fire control systems can be combined and distributed to each element of a networked force. It is simple in concept but very complex to develop and implement. There are many factors besides the horizon that can effect radar detection and so individual radars sometimes have gaps in their tracks. But these gaps can be covered by other radars in the network and thereby producing a composite picture with the help of data fusion. Each unit in the CEC network carries out data fusion with data received from the other units. As a result, units in the network share a common, composite and real-time air-defence picture. The CEC when inducted in the navy provides the following synergised air picture:
  - The synergised air picture is based on all the data available and is thus superior to that of any single sensor, providing tracks with identical track numbers throughout the net.

**Amphibious and Littoral operations**:
- Operating in the littoral pose a complex war fighting challenge as the operations are conducted where merchant and civilian shipping may also operate, besides clutter created by terrain and urban environment for the radars. Such an environment will require integration of sensors and combat systems in a common tactical picture. The CEC thus has war fighting capability during amphibious operations by allocating radar sectors in an integrated manner in order to provide gap free coverage.

**Airborne EW Aircraft**:
- Data inputs from CEC equipped airborne EW aircraft will extend this coverage even further, providing surface units more accurate tracking and situational awareness at ranges well beyond shipboard sensor coverage. At present Indian Navy does not have such an aircraft, but if acquired in the future, it will certainly improve the operational effectiveness.

**Ballistic missile Defence**:
- CEC contributes to theater ballistic missile defense by providing a continuous fire control quality track on the missile from detection to destruction.

**IT-21**:
- IT-21 is a US Naval term which means IT for the 21st Century. However, it can be applied to any navy as it is the establishment of intranet for transmitting tactical and administrative data with the help of desktop computers, data links and networking software. This is meant for the operations at sea with the fleet. The US Navy plans to build IT-21 around commercial, off-the-shelf desktop computers and networking software which should be capable of providing multimedia intranet to include text, data, graphics, images, voice, and video. The US Navy believes IT-21 will significantly improve the US naval war-fighting capability and achieve substantial cost reductions by significantly reducing the time and number of people required to carry out various tactical and administrative functions.

**The US Navy’s FORCEnet**
- The US Navy has a global role and so their Net Work Centric Operational network has been modeled around a concept called FORCEnet. SEA POWER 21 is the US plan to model their navy to face the challenges of the 21st century. Its critical components are:
  - Sea Shield, Sea Strike and Sea Basing. Sea Shield will provide naval capabilities related to homeland defence, sea control, assured access, and projecting defence overland. Sea Shield is a broadened concept for naval power projection and Sea Basing projects, the sovereign power of the US globally. FORCEnet assists Sea Shield, Sea Strike and Sea Basing in transforming the fleet into a fully netted combat force. It integrates sailors, sensors, networks, command and control platforms, and weapons into a fully netted combat force. The US Navy had learned the hard way about the lack of interoperable communications and systemic command and control problems in Grenada in 1983, Operations Desert Shield and Desert Storm in 1990-91 and Kosovo in 1998. They have applied the lessons learnt from the past and improved upon their networking.

Any navy will have to develop new tactics, doctrine, and organisations to exploit the full potential of NCW. It would also affect the type of personnel to be inducted into the navy, training norms and leadership culture. The future fleet design will also have to be gradually conform to the concept of NCW. The Indian Navy has to take stock of all these factors and also their future role including power projection while undertaking the NCW concept.
I have followed with great interest India's development of its emerging Aegis-class destroyer USS Hopper (DDG 70) launches a standard missile (SM)
The Indian Navy (IN) had planned to undertake an adventure voyage of 21,600 nautical miles (40,800 km) around the world single-handedly. Since 2005, "Sagar Kamadhenu" had the following features:

- Will circumnavigate the globe from West to East or vice versa in the Southern Hemisphere.
- The voyage would include stoppages at major ports and stops along the way, including:
  - Doha Exhibition Centre, Qatar
  - Arlington, Arlington, DC Metro Area, USA
  - Sheraton National Hotel & Spa, Washington, DC
  - Sheraton San Diego Hotel & Marina, San Diego, CA, USA
  - Marina, San Diego, CA, USA

On an formal request from the Government of India, the IN had deployed INS Satavahana (Offshore Patrol Vessel) with a Chetak helicopter and Marine Commandos for surveillance of Exclusive Economic Zone (EEZ) of Mauritius from early March to mid-June 2009. The ship has been deployed on a one-month mission, ensuring stability and peace in the Indian Ocean region.

May 2009, originally requested funding for eight new ships. This included two relatively expensive, high-capability combat vessels: Virginia Class Submarine and a DDG-51 class Aegis destroyer and six relatively inexpensive vessels (three littoral combat ships (LCS), two T-1 auxiliary ships for minesweeping and one joint high speed vessel (JHSV)). The navy in September 2009 reduced the LCS request to two ships, reducing the total requested number of all types of ships to seven, of which five were relatively inexpensive LCSs, T-1s, and JHSV.

The navy's proposed FY2009 budget also requested procurement funding for certain navy ships that were procured but not fully funded in previous years, and increased procurement funding for certain new ships.

Goodrich to supply composite components for Virginia Class Submarines

Goodrich Corporation has received a $45 million ($2.31 billion) contract from Northrop Grumman Shipbuilding to provide a number of composite components for the next eight Virginia Class submarines: collectively referred to as Block III. Goodrich's Engineered Polymer Products team in Jacksonville, Florida is building components to support the construction of one ship per year in 2009 and 2010, rising to two ships per year from 2011 through 2013. The components include the bow dome, and sonar and weapons equipment. The Virginia Class submarines are the third class designed for the post-Cold War era. Unobtrusive, non-proliferative and connected with land, air, sea and space-based assets, the Virginia Class submaries are equipped to wage multi-dimensional warfare across the globe, providing the US Navy with continued dominance in oceans and the open sea.

Pentagon contract for Bell-Boeing project

The US Navy's proposed FY2009 budget, submitted in March, included funding for eight new ships. This included two relatively expensive, high-capability combat vessels: Virginia Class Submarine and a DDG-51 class Aegis destroyer and six relatively inexpensive vessels (three littoral combat ships (LCS), two T-1 auxiliary ships for minesweeping and one joint high speed vessel (JHSV)). The navy in September 2009 reduced the LCS request to two ships, reducing the total requested number of all types of ships to seven, of which five were relatively inexpensive LCSs, T-1s, and JHSV.