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Gen Bikram Singh

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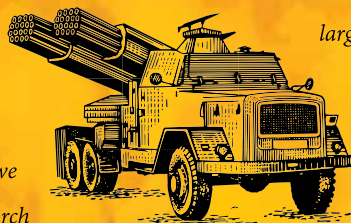
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GENERAL BIKRAM SINGH**

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As we move into the eighth edition of Defexpo 2014, there is growing optimism that India will be on track towards its goals of national security, driven by a sense of urgency not just to equip the armed forces with the most modern equipment, but also to ensure that the Indian defence industry gains a foothold. The impending general elections and a firm government in place thereupon should help clear the atmosphere.

Nevertheless, the defence sector continues to expand, opening up enormous opportunities for both domestic and international players. The fact that over 500 exhibitors will be at the show is testimony to the fact that there are opportunities to grab, of course, they are not without challenges.

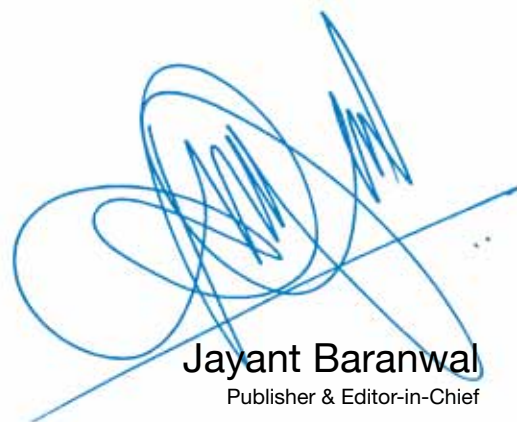
Keeping this in mind, *SP's Special Supplement* gives an overview of the promise that the defence industry holds. Beginning with an interview with the Chief of Army Staff, General Bikram Singh who spells out the roadmap for army modernisation, we have an article on 'India's armour profile' by Lt General (Retd) V.K. Kapoor which dwells on how the Indian Army needs to spell out its priorities as far as induction and modernisation programmes of battle tanks is concerned. One of the main concerns is the delays in decision-making with regard to equipment purchases.

With regard to equipment purchase, the Defence Procurement Procedure (DPP) 2013 becomes highly relevant on how it is going to make things easier for the armed forces to procure equipment. In this context, we have an article by Brigadier (Retd) Rahul Bhonsle indicating how the DPP 2013 is an improvement over DPP 2011. The DPP 2013 spells out stronger and strategic partnership opportunities for foreign original equipment manufacturers (OEMs) by relaxing the conditions to choose offset partners.

As indigenisation gains momentum, India will be looking at concluding meaningful partnerships with several countries, particularly the United States which, undoubtedly, is way ahead in the kind of products and solutions they have to offer. Indo-US relations are on the upswing and we have an article reflecting this trend. The foreign OEMs are aware of India's technology concerns and have been showing keenness to partner with Indian companies and for that to fructify as quickly as possible, there is an urgency to create an ecosystem for co-production.

The Special Supplement features articles on fast patrol crafts, naval radar, cyber warfare capability, electronic warfare strategy and more, giving a perspective of India's massive requirements.

We at SP Guide Publications take immense pride in associating with Defexpo 2014 which is a perfect platform to promote defence industrial base. As we celebrate our Golden Jubilee, we reiterate that we will continue to partner with the industry to further the cause of national security.



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‘The budgetary allocation to the Army in the recent years has been fairly consistent’

The Chief of Army Staff General **Bikram Singh** says that his single most important area of focus is to ensure the highest state of operational preparedness. In an exclusive interview with **SP Guide Publications**, he assured that with high levels of motivation and morale, the Indian Army is fully prepared to take on the present and future challenges with elan and professionalism.

SP Guide Publications (SP's): You have now been the Chief of Army Staff for more than a year. Which are the areas within the Army or in your relationship with the Ministry of Defence (MoD) where you have been able to positively influence matters and set into motion some long-term corrective measures/reforms?

Chief of Army Staff (COAS): As the Army Chief, it is my bounden responsibility to chart a course that prepares the Army to meet future threats and challenges effectively and continues to live up to the faith and trust that the nation has reposed on its soldiers and commanders.

To start with, on taking over as the Chief of Army Staff, I had laid down certain ‘thrust areas’ to realign the focus of the Indian Army. These form the foundation of a comprehensive approach to building an Army that remains a ready, potent, responsive and accountable instrument of national power—a vision that I have articulated time and again.

To ensure the highest state of operational preparedness is my single most important area of focus. Another critical challenge remains that of force modernisation and capability build-up. It has been my endeavour to bring in greater transparency and accountability in our policies and procedures. Financial

probity is integral to maintaining and preserving our core values, which form the basic edifice of our strength and structure.

Our soldiers remain our most precious resource. A review of the human resource policy is already under way to meet individual aspirations and organisational needs. I have maintained that as an organisation we need to cut down on activities that do not have a bearing on our operational preparedness. I am also committed to creating an environment that offers challenging opportunities to our junior leadership.

There is greater synergy now, both with the MoD as well as with sister services and all other agencies, who are the stakeholders in national security, something that I have upheld as a prerequisite to achieving our common aim and purpose.

I have always maintained that our veterans, veer naris (brave women) and widows who have made tremendous sacrifices are our strength and it is our duty to look after their well-being. Special cells for ex-servicemen have been set up at all headquarters. To usher all ranks into their second innings, placement nodes have also been created under Army Welfare Placement Organisation (AWPO). In addition, special discharge drills are being conducted at Delhi for officers and at Regimental Centres for Junior Commissioned Officers and other ranks.

My efforts thus have been towards moulding the Army into a cohesive, confident and effective force and bringing about a wellness that permeates across the rank and file. Let me assure

'DUE TO THE SPECIAL EMPHASIS LAID ON INDIGENISATION BY THE DEFENCE MINISTER, AS REFLECTED IN THE FOREWORD OF DPP 2013, I AM CONFIDENT THAT THERE WILL BE PROGRESSIVE IMPROVEMENT IN THE COMING YEARS'

the nation that with high levels of motivation and morale, the Indian Army is fully prepared to take on the present and future challenges with elan and professionalism.

SP's: Which are the areas where you have not been able to make any headway despite a strong desire on your part to do so and what is preventing you from doing it?

COAS: There is no area where progress has not been made. We have made headway on all fronts, albeit the pace may be slightly slow in certain cases.

Long-term processes need to be imparted with impetus to achieve our vision. Capability building requires time, commitment and resources. Most projects have long gestation periods and are spread over many years. The progress has to be viewed in this context. There are areas where the progress has been slower than what is expected. Modernisation of the Indian Army requires to pick up pace. In-house processes are already being refined and the government's continuous focus and support is critical. Defence infrastructure development in view of the cur-

rent and future threats would require focused commitment.

Another area that assumes importance is indigenisation of defence industry, greater opportunities and role of private players and a boost to defence related research and development (R&D). We are quite hopeful that the positive impact of the efforts that have been put in this direction should be visible in the near future as it has far-reaching implications on our self-reliance in defence equipment and capabilities.

SP's: Of late, it seems China has been far more aggressive on the line of actual control (LAC) than in earlier years and the conduct of the People's Liberation Army/Border Guards has been aggressive, to say the least. What is the Army's appreciation of China's intentions of adopting the current tactics and aggressive stance?

COAS: I do not agree with your initial statement. Few border incidents that took place have been unduly hyped up. These isolated incidents must be viewed in the overall context.

Peace and tranquillity prevail along the LAC and border areas as a result of commitment by both nations to abide by existing bilateral agreements and protocols. In addition, mechanism of Border Post Meetings (BPM)/Flag Meetings has been effective in resolving most border issues. Further strengthening of confidence building measures (CBM) has been achieved by the Border Defence Cooperation Agreement (BDCA) signed during the Prime Minister's visit to China on October 23, 2013.

SP's: The delays in modernisation of the Indian Army are well chronicled and the reasoning has also been understood generally by military analysts. However, that gives no satisfaction to soldiers and formation commanders who face our adversaries at the borders where small skirmishes may well escalate into border conflicts. As the COAS, are you satisfied with the current holdings and the status of equipment and munitions for war?

COAS: Modernisation of the Indian Army is a continuous process that ensures the Army is fully capable of meeting any threat in the operational environment prevailing on our borders. Efforts are ongoing in conjunction with the Ministry of Defence to enhance the capability of indigenous weapons and equipment. It would be reasonable to state that our soldier is well-equipped for any operational contingency.

Ammunition management is a dynamic process wherein consumption and recoupment of any deficiency is a function of production capacities of ordnance factories and availability ex import. A comprehensive long-term Ammunition Roll on Plan for continued build up of ammunition reserves in a phased manner is already being implemented on approval by the MoD.

SP's: A Mountain Strike Corps stands sanctioned by the government. Among the veterans the view persists that mere raising of more manpower, without tactical and operational level aviation resources, long-range firepower, reconnaissance and surveillance resources and many other force multipliers would be marginal value. May we have your observations on this important issue?



COAS: The capability of an Army is an amalgamation of equipment and manpower, both of which are processed simultaneously for capability enhancement. Indian Army periodically carries out realistic threat assessments and formulates the capability required for undertaking its mandated charter. Accordingly, modernisation and force structuring are formulated and approved by the government. Whenever accretions are sanctioned, the requisite combat support, reconnaissance, surveillance and logistic components are also sanctioned along with it.

SP's: Considering the pull out of the North Atlantic Treaty Organisation (NATO) and the US forces from Afghanistan in 2014, how does the Army assess the situation in Afghanistan-Pakistan region and how will it impact the Indian Army?

COAS: The turmoil in Afghanistan-Pakistan region and recent security developments are definitely an issue of concern. With the stated pull out of troops by the United States in 2014, the security dynamics in the region will undergo a change. Being part of the region, these changes are bound to have certain implications for India as well.

SP's: There has been inordinate delay in raising and establishing the Indian National Defence University (INDU). When is the INDU likely to be established and what are the formalities that are still to be completed?

COAS: The process of setting up of INDU is on a fast track mode after acquisition of land at Binola and Bilaspur villages in Gurgaon and subsequent foundation stone laying ceremony by the Prime Minister of India in May 2013.

Detailed project report along with the layout plans have been submitted by the Education Consultants of India Ltd (EdCIL), a Ministry of Human Resource Development (MHRD) enterprise, and the Revised Cabinet Note is in the process of being sent for inter-ministerial consultations. Simultaneously, INDU Act is also being prepared by the con-

sultants and is likely to be submitted to MoD at the earliest. This will also be put through inter-ministerial consultations after which it will be tabled in the Parliament. After the passage of INDU Act, all other processes of tendering, contracting and executing the project will commence including award of degree to affiliated colleges. It is expected that the entire infrastructure will be ready and the University fully functional by end 2018. Headquarters Integrated Defence Staff (HQ IDS) is closely working along with MoD and other consultants for early setting up of INDU as per the timelines approved by the Defence Minister.

SP's: Have the plans to make the Army's Special Forces and Infantry Ghatak Platoons more potent and effective, been realised? What is the new equipment, if any, that has been inducted to ensure this?

COAS: The modernisation plan of Special Forces involves increased firepower, survivability, situational awareness and command and control to operate across the entire spectrum of conflict. In addition, modernisation of aviation assets and increasing airlift capability will further enhance their operational reach. With new technologies coming in, modernisation and capability development of our Special Forces would remain an ongoing process, one that is accorded high priority in our planning and procurement processes.

The Special Forces have been equipped with modern weapon systems along with surveillance and target acquisition devices as part of their capability enhancement to conduct mandated tasks both by day and night. Besides this, action is at hand to ensure high mobility of our elite forces, be it on land, air or sea. As regards the Ghatak Platoon of Infantry Battalions, a composite package of additional equipment and devices for special operations, referred as 'Ghatak Brick', is also in the pipeline. This upgradation would facilitate the Ghatak Platoons to conduct their tasks with enhanced efficiency and comparative ease in conventional as well as sub-conventional operations.

SP's: Recently it was reported in the media that Naxals are raising battalion-sized units for future operations. Does that indicate a role for the Army undertaking anti-Naxal operations in the future?

COAS: Anti-left-wing extremism (LWE) operations are being coordinated and conducted by the Ministry of Home Affairs (MHA) in conjunction with the affected state governments. Our Central Armed Police Force (CAPF) are fully geared and competent to take on the challenge. The Army is only in an advisory capacity and is providing training to the state police/CAPFs as and when required.

SP's: In a fairly large number of incidents in the past few months in Jammu and Kashmir (J&K), it seems that Army units and subunits have suffered casualties due to their own laxity. While we have no doubts that orders including standard operating procedures do exist to prevent such happenings, why are they being flouted, especially in areas where alertness and readiness are paramount for their own safety and security? Are there any other reasons for this obvious flaw?

COAS: The situation in J&K was improving as was evident from all parameters which clearly pointed to an early return of relative normalcy. This was obviously due to the relentless efforts of the Indian Army ably supported by all elements of our security apparatus.

Viewed in retrospect the repeated calls for revocation of the Armed Forces Special Powers Act (AFSPA) were perhaps on account of the improved security situation. However, there was a need to further consolidate and stabilise the security situation, lest any premature action neutralised the advantage gained by the relentless offensive action of our soldiers.

There have been isolated violations of standard operating procedures (SOPs), however, remedial recourse has been effected. These aberrations notwithstanding, we must never trivialise the sacrifices of our brave soldiers. As the COAS, I salute all my soldiers, who in the line of duty and best traditions of our Army have made the supreme sacrifice.

SP's: How long will it take the Indian Army to be ready for network-centric operations? What is holding it back?

COAS: Network-centric operations involve development of information and communication technology (ICT) infrastructure and suitable applications. While our networks at strategic and operational level are well developed, we need mobile and flexible tactical communication system (TCS) to be fielded at the earliest. At the same time, while some applications have been fielded successfully, others are at different stages of development through indigenous production by the Defence Research and Development Organisation (DRDO) and defence public sector undertakings (DPSUs), in keeping with security considerations. I would also like to highlight that in the field of ICT, the development cycle has to be telescoped to beat technological obsolescence. The above notwithstanding, I expect the Indian Army to be network-centric in line with our laid down objectives in the days ahead.

SP's: We are exercising with various friendly foreign countries. Have these exercises in any way impacted the opera-

tional/equipment philosophy of the Army?

COAS: The combined exercises are aimed at achieving desired capability during operations that may be undertaken in the aftermath of a disaster situation or for operations against terrorists under the aegis of the United Nations. Such exercises also enable the development of minimum inescapable interoperability, which is essential for achieving the synergy between two Armies.

The Indian Army has benefited immensely from this exposure, both operationally as also with respect to technology related issues.

SP's: At the current level of budgetary allocation for defence, the procedural complexity that effectively precludes the full utilisation of allocated funds within the financial year and the hesitancy of people in charge in taking procurement decisions, will the Indian Army be able to equip, upgrade and modernise in conformity with existing plans? Very little has been achieved in the Twelfth Five Year Plan, therefore given the above environment, what makes us confident that it will be achieved in the future?

COAS: Defence acquisition is a complex process that needs to balance the competing requirements of expeditious procurement, development by indigenous defence sector and conformity to the highest standards of transparency, probity and public accountability. High levels of public probity and media scrutiny impose a degree of caution, making the process more deliberate, as tenets of the Defence Procurement Procedure (DPP) have to be followed conscientiously.

While there have been some time overruns, it would be incorrect to state that very little has been achieved in the Twelfth Five Year Plan. Thirty-nine contracts have already been concluded in the Twelfth Plan. A significant number of schemes linked to the modernisation of Artillery, Army Air Defence and Mechanised Forces are in fairly advanced stages of procurement and ought to fructify within the Twelfth Plan.

The budgetary allocation to the Army in the recent years has been fairly consistent. The Army has carried out a holistic review and re-prioritisation to accelerate capability development. I have also constituted a Higher Forum on Operational Preparedness and Modernisation under the Vice Chief, which is closely monitoring all modernisation efforts. The Army remains committed to accelerate procurement and maximise operational readiness. We have set achievable targets and are making steady progress. The numerous initiatives have already started showing results. In the current financial year, we have far surpassed the results of previous years.

Streamlining and refinement of the procurement procedure is a continuous process. Experience gained has adequately been subsumed in successive versions of the Defence Procurement Procedure. MoD as well the three services have taken great care to minimise systemic deficiencies of all nature and are working in unison to ensure timely and unhindered procurement. Due to the special emphasis laid on indigenisation by the Defence Minister, as reflected in the foreword of DPP 2013, I am confident that there will be progressive improvement in the coming years. ■



Prime Minister Dr Manmohan Singh and President Barack Obama at a summit meeting in the White House last September

Dynamics of Indo-US Relationship

It appears that Indian and American efforts to strengthen the “strategic partnership” have attained a matured level and are not likely to be abandoned due to any single issue of variance. The fundamental relations appear to be strong and hiccups on the way would not damage the underlying structure of the partnership.

By Chintamani Mahapatra

India's relations with the United States have always been a dynamic one. Despite diverse approaches to economic growth strategy, issues of Cold War and regional security developments; India has every time succeeded in maintaining a working relationship with the United States. The end of the Cold War brought new challenges and opportunities for both the countries to adopt innovative methods to give new directions to their relationship. The collapse of the USSR, weakening of Washington's Cold War driven alliance with Islamabad removed major irritants in their relationship, while Indian economic reforms in the early 1990s promoted deeper trade and

investment relations between India and the United States.

Although India's decision to turn itself into a full-fledged nuclear weapon power flew on the face of American nuclear non-proliferation regime in late 1990s and threatened to derail post-Cold War camaraderie between the two countries, President Bill Clinton came on a mission to India in March 2000 to befriend the nuclear India. It was Mission Possible and the early years of the 21st century witnessed a new paradigm of the US-India cooperative endeavour.

Republican President George Bush, Democratic President Clinton's successor, systematically built on the edifice

laid by Clinton-Vajpayee New Delhi Summit and during eight years of his presidency elevated the bilateral relationship to newer heights. India and the United States conscientiously constructed a strategic partnership that turned out to be resilient and it encompassed a very wide range of engagements in every possible area of political, economic, military and strategic cooperation. While trade and investment ties were quite normal, the novel areas of US-Indian cooperation included regular military exercises, joint development of doctrines, defence trade, transfer of dual use technology, and more significantly an agreement to cooperate in civil nuclear programmes.

What were unthinkable during decades of Cold War turned out to be customary and normal aspects of bilateral interaction. Significantly, a broad consensus emerged in India to carry forward the strategic ties with the United States. The change of government from NDA-led coalition to UPA-led coalition did not fundamentally alter the direction of India's relations with the United States. Same was true in the case of the US domestic political consensus, as there was bipartisan support to improve American relations with India in the US Congress. Consequently, when Barack Obama succeeded George Bush, he further carried forward the strategic partnership. He turned out to be the first American President to visit India during his first term and to announce the US support for India's permanent membership in an expanded UN Security Council and India's entry into non-proliferation regimes, such as the Nuclear Suppliers Group (NSG), Missile Technology Control Regime (MTCR), etc.

Altered Asian Geopolitics

Today, the strategic convergence of views between the Indian and the American policy-makers has created a new geopolitical landscape in the Indo-Pacific and Asia-Pacific region. First, the two countries share a common vision of a peaceful, prosperous and stable Asia-Pacific that would not be dominated by any single power. Second, India and the United States have coordinated approach to regional cooperation mechanisms and both are active participants in several multilateral forums in the region, such as East Asia summit, Association of South East Asian Nations (ASEAN) Regional Forum and ASEAN-sponsored dialogue forums. Thirdly, Washington and New Delhi maintain a common position on the need to maintain safety and security of sea lanes in the Indian Ocean and the navies of the two countries have been regularly conducting joint exercises as part of that understanding. India recently facilitated America's entry into the IOARC as an observer.

Third, unlike in the past, India and the US have joined hands to combat terrorism. The counterterrorism cooperation and intelligence sharing between the two countries is unprecedented in scope today. Fourth, the nuclear discord between the two countries became a thing of the past once they inked an agreement to pursue nuclear commerce and India cooperates with the US in promoting non-proliferation of weapons of mass destruction (WMD) around the world. India's cooperation in the US efforts to manage the nuclear programme of Iran is a case in point, where

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India more than once sided with Washington's position in the International Atomic Energy Agency (IAEA). While the critics in India saw in this exercise India capitulate to American diktat and cynics in the US complained that India was not doing enough to isolate Iran, the two governments seem to have appreciated each other's nuanced position and careful initiatives to address the Iranian nuclear question.

Thus the goals of Asian stability, managing energy security, combating terrorism and securing sea lines of communication have marked the strategic convergence of interests between the two democracies

Obstacles and Challenges

The Indo-US strategic partnership, however, has not been without hurdles and challenges. There have been enormous areas of security-related, economic and political issues where the leaderships do not yet see eye to eye. Such divergent views nonetheless have not prevented the two countries from moving ahead with agreeable items of cooperation and collaboration.

The security issues involve developments in Pakistan and the methods of addressing them. President George Bush successfully managed to maintain cordial ties with both India and

with India. The Indian Government also on multiple occasions opposed a hasty withdrawal of the US and NATO troops from Afghanistan, but it fell on deaf ears in Washington.

Relations with China too have witnessed differing approaches. The US has been a close economic partner of China with billions of dollars of two-way trade and investment. Yet, China and the US are increasingly becoming strategic competitors. Washington seems to be adopting certain policies that would protect its economic interests in China but simultaneously would restrict China's rise as a major strategic rival. The "pivot to Asia" strategy of the Obama Administration, also known as Asia rebalancing, expects India to be a linchpin of the strategy. India, however, is reluctant to embrace a US-led policy that would unnecessarily complicate its own approach towards managing a rising superpower along its border. Neither India nor the US openly supports any containment strategy towards China. Neither of the two would like China to be a rival or a competitor. Both seek to engage China, but the approaches are different and coordinated method is likely to raise suspicions in Beijing. Managing the rising power of China will be a persistent challenge to the Indo-US strategic partnership.

There are several other bilateral issues where considerable differences remain between the two countries. The Obama Administration's stance of "outsourcing", for instance, goes against India's interests. American companies outsourcing jobs to countries like India are punished through fiscal measures and those who give up outsourcing practices are rewarded with tax breaks. While the Obama Administration seeks to protect the American jobs, large numbers of Indians are thrown out of their jobs in the process. Second, a new immigration bill currently pending in the US Congress is believed to adversely affecting the Indian IT companies operating in the United States. Third, American companies seeking to conduct business in India complain against lack of market opening in India, especially in the banking and insurance sector and the vast retail sector in India. Fourth, India and the US happen to be on the opposing side of the dividing line on climate change issues and agricultural trade negotiations. Last but not the least, Washington and New Delhi occasionally indulge in diplomatic spat, as for example, over the issue of diplomatic immunity.

Nevertheless, such differences have not prevented Indian and American policy-makers from undertaking the main project of forging a "strategic partnership". No two alliance partners, for instance, are free of differences on issues and events. India's strategic partnership with the United States is actually a work in progress and temporary obstacles are but natural part of the process. Moreover, convergence of interests between the two countries does not necessarily mean complete merger of interests. The relationship between nations is always guided by respective national interests and the goal of diplomacy is to narrow the areas of differences and promote common goals. To that extent, it appears that Indian and American efforts to strengthen the "strategic partnership" have attained a matured level and are not likely to be abandoned due to any single issue of variance. The fundamental relations appear to be strong and hiccups on the way would not damage the underlying structure of the partnership. ■

The author is a well known strategic analyst and a Professor at Jawaharlal Nehru University in New Delhi

INDIA'S STRATEGIC PARTNERSHIP WITH THE UNITED STATES IS ACTUALLY A WORK IN PROGRESS AND TEMPORARY OBSTACLES ARE BUT NATURAL PART OF THE PROCESS

Pakistan by adopting a balanced approach that de-hyphenated Indo-Pakistan issues and simultaneously promoted positive ties with both the South Asian countries. By improving defence and security relations with India and signing a civil nuclear cooperation agreement, the Bush Administration sought to prevent India from complaining much against elevating Pakistan to a major non-North Atlantic Treaty Organisation (NATO) ally status. President Obama adopted a tougher approach towards Pakistan, but relationship with India appeared standstill and Pakistan had little to complain about the Indo-US ties. However, the main sticking point was the US approach to anti-India terrorist groups within Pakistan. In order to win Islamabad's concurrence in the Afghan front, both the Bush and the Obama Administrations, in Indian perspective, neglected anti-India terrorist activities launched from Pakistani soil.

India and the United States also differed on the Afghanistan issue. While India appreciated Washington's encouragement for growing Indian role in the civil sectors of Afghan reconstruction and prevented Pakistan from exercising a veto on Indian participation in Afghan affairs, the US by and large kept India out of the loop on its initiatives towards promoting Afghan reconciliation. New Delhi, after investing a couple of billions of dollars in Afghanistan, demanded a role in the process of Afghan reconciliation. The US, nonetheless, chose to open dialogues with the Taliban without prior consultation



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PHOTONIS Night Vision Sensors for operations

WORLD LEADER OF NIGHT VISION SENSOR INNOVATIONS

During the news coverage of a senior NATO officer's visit to Afghanistan, when he asked if there was anything specific in fact the soldiers needed; the reply was instantaneous "more NVG's (Night Vision Goggles) Sir". This response cements the necessity of NVG's in the present and future conflict zones. NVG is a post World War II development. It is no longer a luxury item for the modern soldiers but vital equipment, supporting their survivability. NVG's have the unprecedented features of being easy to deploy and to maintain, of providing a unique identification performance by night and to be very rugged, unlike any other opto-electronic devices. Thus NATO countries are leading the way by massively equipping all of their troops with at least one NV device per soldier.

Also during the 2008 Mumbai attacks which began on 26 November 2008 and lasted until 29 November, Night Vision was of importance. Night actions have taken place, by the early morning of 28 November, all sites except for the Taj hotel had been secured by Mumbai Police and security forces.

Night Vision is of crucial importance for India, as recent terror events have shown again e.g. the vulnerability at night of armed and security forces.



NEW TECHNOLOGY

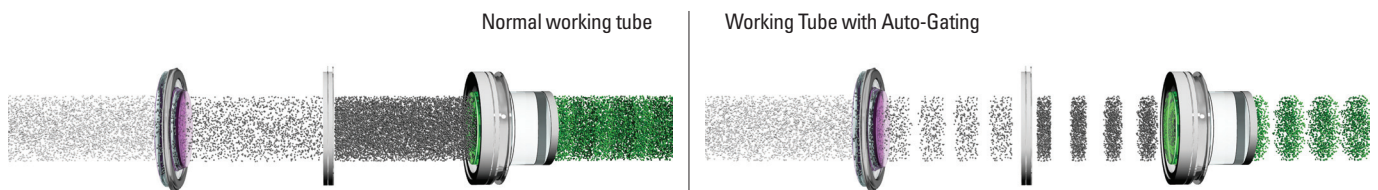
Recently, one of the most revolutionary advancements in night vision has been introduced in the XR5™ auto-gated filmless tube from PHOTONIS. In addition to improvements in image resolution and clarity as well as low-light level performance, the XR5™ offers "Auto-Gating" which allows for continuous operation in dynamic light conditions. XR5™ is one of the most recent image intensifiers

in service in NATO.

XR5™ overview with Auto-Gating

The XR5™ Image Intensifier reveals even the minute details of the night and offers extensive capabilities. XR5™ technology enables the user to detect information easily during all types of operations. Its unmatched wide spectral sensi-

PHOTOGRAPHS: PHOTONIS



tivity enables the soldier to operate in all star- or moonlight conditions, in desert, arctic, wooded or jungle operational environments. The prominent feature on the XR5™ is the integrated autogated power supply. Auto-Gating is the electronic solution that reduces the duty cycle of the photocathode voltage by rapidly switching the voltage on and off. The Auto-Gating provides the unique feature of keeping the nominal MTF and resolution of the tube at high light levels (urban environment, above cities for pilots, ...) unlike standard tubes whose resolution would drop to less than 20 lp/mm at high light levels.

How the AUTOGATING can save the life of warfighters?

The image provided by an autogated tube keeps therefore in all conditions of light the best contrast. Dynamic lighting conditions define many of today's missions. Having a device fitted with Auto-Gating might be a true life saver in emergency situations, such as field explosions, sudden flashes of light or in a twilight environment where a standard image intensifier would usually switch off lens focus.

XR5™ Image Intensifier represents the new standard for night vision and is available in a variety of inverting and non-inverting 18 mm formats (form - fit - function) for existing and new optical

systems (goggles whatever their origin, monocular or weapon sights). XR5™ has clearly been recognized as the most high end sensor available without restriction. Program leaders clearly understand now that what count in actual operation are the performance parameters of the product, and not the type of components used (also known as generation of the tube).

ONYX

In addition to the advances made with XR5™ Auto-Gating, ONYX natural black and white Night Vision Image Intensifiers are proving to be a plus in terms of image contrast and detection. ONYX is the optional black & white (B&W) vision of PHOTONIS.

Studies show that nighttime scenes appear remarkably more natural in B&W versus the usual green. PHOTONIS offers B&W Night Vision for them who want to have a natural vision at night. B&W provides clearer information about the contrast, shapes and shadows. In addition, the feedback from soldiers operating on the ground in Afghanistan and Iraq indicated that there is "a strong preference for the white phosphor NVG" when operation in a rocky or sandy environment. ONYX is available as option on XD4™ and XR5™.

About PHOTONIS Night Vision

PHOTONIS Night Vision is the world leader in Night Vision Technology Innovation specialised in the design and manufacturing of state-of-the-art image intensifier tubes for space and military applications. Night vision has become a key optoelectronic technology in modern warfare as more and more operations take place by night. PHOTONIS Night Vision products are in use in all NATO countries and are largely deployed worldwide.

PHOTONIS Technologies is a global business serving the photo-sensor technology needs of world-leading customers in the areas of Night Vision, Industry & Science and Medical Imaging. The Group develops and manufactures for instance Image Intensifier Tubes for civilian and military use, Micro-Channel Plates for mass spectrometry and space science and Gas Nuclear Detectors for the safety of nuclear power plants.

PHOTONIS directly export more than 80 percent of their products. Major customers include; INDIAN ARMY, FRENCH ARMY, UK MoD, GERMAN ARMY, US ARMY CECOM, US NAVY and for civilian applications AREVA, EDF (French Power Utility), CEA (French Nuclear Commission), CNRS (French Research Center), US NATIONAL LABS, ESA. ■

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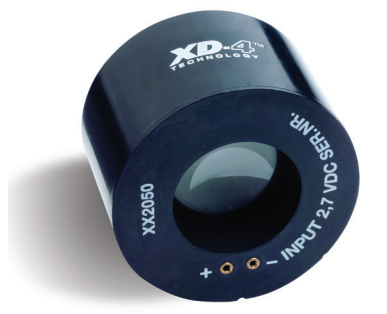


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XR5 Auto-gating



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DPP 2013 vs DPP 2011

A comparative overview of DPP 2013 and DPP 2011 would indicate that for the first time, there is greater clarity on defining indigenisation and how this is to be achieved. Attempts have been made to establish a level playing field between the public and private sector as well as Indian and foreign vendors. Effective monitoring of offsets is envisaged, thereby ensuring value addition in terms of transfer of technology.

By Rahul Bhonsle



US Army AH-64
Apache attack
helicopter

Procurement for the armed forces in India is governed by the Defence Procurement Procedure (DPP). These regulations were adopted as an outcome of the Group of Ministers Report on national security reforms in 2001. The Ministry of Defence (MoD) set up Defence Procurement Management Structures and Systems and the first DPP was issued in 2002. The DPP is revised every two years based on experience gained in implementation, requirements of the services and developments in defence research and development (R&D) and industry. This has led to considerable refinement in defence procurement to include introduction of offsets and integrity clause, improvements in the 'Make' Procedure

and sustained focus on indigenisation.

DPP 2013 promulgated by the MoD on June 1, 2013, is a result of this progressive evolution and is a follow-up of DPP 2011.

The thrust areas identified in DPP 2011 were expansion of offset eligibility to include civil aerospace, internal security and training. The procedure for "Make" under shipbuilding category was also elaborated. DPP 2013 on the other hand includes some fundamental changes with greater thrust given to indigenisation. Broadly speaking, DPP 2013 is a more comprehensive document. This is also obvious from the sheer volume of 428 pages in DPP 2013 as against 291 pages of DPP 2011.

Covering some of the specific issues, for the first time a preferred order of categorisation has been outlined in DPP 2013 which defines the order of priority for procurement from indigenous sources. Thus the Categorisation Committee while considering capital acquisition has to ensure that the following priorities are adhered to:

- Buy (Indian)
- Buy & Make (Indian)
- Make (Indian)
- Buy & Make
- Buy (Global)

There are no fundamental changes in categorisation in DPP 2011 and 2013 which remain the same as follows:

Acquisitions covered under the 'Buy' decision: 'Buy' means an outright purchase of equipment. In 'Buy (Indian)' and 'Buy (Global)', Indian would mean Indian vendors only and Global would mean foreign as well as Indian vendors. 'Buy Indian' must have minimum 30 per cent indigenous content if the systems are being integrated by an Indian vendor.

Acquisitions covered under the 'Buy & Make' decision: 'Buy & Make' decision means purchase from a foreign vendor followed by licensed production/indigenous manufacture in the country.

Acquisitions covered under the 'Buy & Make (Indian)' decision: 'Buy & Make (Indian)' decision mean purchase from an Indian vendor including an Indian company forming joint venture/establishing production arrangement with OEM followed by licensed production/indigenous manufacture in the country. 'Buy & Make (Indian)' must have minimum 50 per cent indigenous content on cost basis.

Acquisitions covered under the 'Make' decision: Acquisitions covered under the 'Make' decision include high technology complex systems to be designed, developed and produced indigenously.

As per DPP 2013, the Statement of Case (SOC) seeking acceptance of necessity (AON) is required to include detailed justification for recommending categorisation as well as reasons why each of the higher preferred categorisation has not been considered. For instance if AON is sought for tank ammunition in the 'Buy (Global)' category which is the lowest in the order of preference, a detailed justification for not considering other higher preferences will have to be given in the SOC.

In a move to ensure timely completion of process of tendering, Service Qualitative Requirements (SQRs) are required to be frozen before AON has been accorded and validity of AON has also been reduced from two years to one year. Thus service HQs will have to complete all formalities including preparation of a draft request for proposal (RFP) to ensure that the AON does not expire, as the period of validity is reduced to one year.

Given the thrust on indigenisation, "indigenous content" has been defined in DPP 2013. This is to be arrived at by excluding from the total cost of equipment/item, the following elements at all stages (tiers) of manufacturing/production/assembly:

- Direct costs (including freight/transportation and insurance) of all materials, components, sub-assemblies, assemblies and products imported into India.
- Direct and indirect costs of all services obtained from non-Indian entities/citizens.
- All licence fees, royalties, technical fees and other fees/payments of this nature paid out of India, by whatever term/phrase referred to in contracts/ agreements made by vendors/sub-vendors.
- Taxes, duties, cesses, octroi and any other statutory levies in India of this nature.

Moreover, this is not restricted to the original equipment



T-90 battle tank



BAE System's
M777 Lightweight
Howitzer

manufacturer (OEM) but extends all the way to the lowest tier of the sub-vendor, and import content in the products supplied by the sub-vendors will not qualify towards indigenous content.

Transfer of technology (ToT) is also defined in various categories in DPP 2013, which had not been included in DPP 2011. This will overcome the ambiguity existing at present. There are five categories of ToT with the highest being where complete transfer is involved and lowest where there will be no transfer. These categories are outlined as follows:

- **Category 1** – Complete transfer of technology.
- **Category 2** – Complete transfer of technology of sub-vendor.
- **Category 3** – Partial transfer of technology with non-transfer of technology of sub-vendor.
- **Category 4** – Only drawings will be provided.
- **Category 5** – Proprietary item – no transfer of technology.

DPP 2013 also specifies for the first time that all commercial transactions including evaluation will be carried out based on international norms as per International Commercial Terms (INCOTERMS 2010). This will bring payment terms for Indian bidders on par with those for foreign bidders; ensure specificity in stages and modes of payment and removal of excise duty in determination of L-1 or lowest bidder.

In an attempt to derive greater benefit from offsets, MoD had issued Revised Defence Offset Guidelines (DOG) which was applicable from August 1, 2012. These have now been included in DPP 2013. The Defence Offset Monitoring Wing (DOMW) has been set up under these provisions and has become functional under the Department of Defence Production (DDP).

The offset proposals submitted by the vendor will henceforth be evaluated by the Acquisition Wing which will also conclude offset contracts with vendors, alongside the main contract. Post-contract monitoring and auditing of offsets will be done by the DOMW. While offsets have been introduced for the first time in DPP 2005, the value derived was limited. Offset monitoring by DOMW is expected to overcome this deficiency.

To establish a level playing field, maintenance transfer

of technology (MTOT) is now open to public as well as private sector. Hitherto fore, MTOT was reserved for ordnance factories and defence public sector undertakings and was done through nomination.

In a boost to the MSME sector, while DPP 2011 had identified setting-up of a fund to provide necessary resources for development of defence equipment, the source has been specifically identified in DPP 2013. SIDBI will earmark an amount of ₹500 crore for providing loans and a fund of ₹50 crore for equity support out of “India

Opportunities Fund” managed by its subsidiary, namely, SIDBI Venture Capital Ltd.

Given the emerging concerns on cyber security, vendors will have to certify that the hardware and software being offered as part of the contract, does not contain embedded malicious code that would inhibit functioning of the equipment or cause physical damage to the user. In such cases, firms will be held liable and will be debarred from participation in future contracts of MoD/Government of India.

Consultations on Security Guidelines for Indian Defence Industry are also required to be issued by the MoD as per DPP 2013. Draft security guidelines that will apply to all licensed defence industries have been circulated for consultations with various stakeholders. This will establish a strong security framework for Indian private industries participating in defence production.

DPP 2013 also has enhanced delegation of financial powers from ₹50-150 crore (\$8.3-25 million) for capital acquisition by the Service Headquarters (HQ). This will to some extent reduce necessity for processing cases to the Defence Acquisition Council (DAC). Approval for all deviations from the DPP however will henceforth be sought from the DAC instead of the Defence Minister.

A comparative overview of DPP 2013 and DPP 2011 would indicate that for the first time, there is greater clarity on defining indigenisation and how this is to be achieved. Attempts have been made to establish a level playing field between the public and private sector as well as Indian and foreign vendors. Effective monitoring of offsets is envisaged, thereby ensuring value addition in terms of transfer of technology. It is now up to the Defence Acquisition Wing and the DDP, the Services and HQ Integrated Defence Staff to ensure that these provisions are implemented to achieve the aim of DPP 2013 that is timely procurement preferably through indigenous sources while deriving best value for money. ■

Brigadier (Retd) Rahul Bhonsle is a strategic analyst and a prolific writer on strategic affairs.

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Indian Army's Armour Profile

Delay in decision-making which is enhanced by the innumerable agencies involved, departmental rivalries, general lack of urgency in getting things done and proper resource management, is affecting the Indian Army's armour profile. What is worrisome today is that even the desired ammunition of tanks is in short supply.

By Lt General (Retd) V.K. Kapoor

The Indian Army needs to spell out its priorities as far as induction and modernisation programmes of their battle tanks are concerned. The delays in decision-making are substantially enhanced by the innumerable agencies involved, departmental rivalries, general lack of urgency in getting things done and proper resource management. What is worrisome today is that even the desired ammunition of tanks is in short supply.

Arjun Tank

The Army had started inducting Arjun tanks as far back as 2004 but it was much later in 2009 that the tank was fielded in strength. The Army equipped two regiments with Arjun tanks out of the 124 Arjun main battle tanks (MBT) ordered by it earlier. As a result of the satisfactory feedback by the units and from the tank crews, an additional 124 Arjun Mark II tanks have been ordered subject to satisfactory development of the upgraded Mark II version of the tank for equipping two more regiments. These tanks will have substantially upgraded capabilities of firepower, mobility and protection. The development of Arjun Mark II tank with 43 improvements has commenced and limited technical trials incorporating the improvements have been carried out in Rajasthan. First batch of MBT Arjun Mark II is likely to go in for production by 2014-15 at the Heavy Vehicles Factory (HVF) in Avadi, Tamil Nadu.

T-90 Tank

As regards the T-90 tanks, 310 T-90S tanks had been ordered from Russia in the first instance. Of these, 124 fully-assembled tanks were directly imported from Russia and 186 kits were imported for assembly in India. The first indigenously assembled T-90S rolled out from the HVF Avadi on January 7, 2004. These tanks have now been fully operationalised. Additional 347 T-90S tanks have been inducted into service which brings the total to 657 T-90S tanks. As per media reports, the Army has till now inducted around 780 of the 1,657 T-90S tanks it eventually wants. The defects in the fire control systems of T-90S tanks due to excessive heat in the turrets during the summers, are being remedied through air-conditioning of the interior.



MBT Arjun MK-I

On September 13, 2013, a major deal was cleared by the Defence Acquisition Council (DAC) for the manufacturing of 236 additional T-90 tanks for the Indian Army. The order, worth over ₹6,000 crore (\$940 million), will be executed by the Avadi Heavy Vehicles Factory that already has a licence from Russia to manufacture T-90 tanks from kits purchased from Russia. Another contract, worth about \$470 million, has been signed for the deliveries of the Invar missiles, which will be installed on Russian-built T-90 tanks. This has to be completed within the next five years. Invar is a laser-guided anti-tank missile with a range of five kilometres and the capability to penetrate explosive reactive armour (ERA). According to local media reports, India plans to purchase 25,000 Invar missiles for its T-90 tanks, including 10,000 to be procured directly from Russia and 15,000 more to be manufactured domestically under a Russian licence.

Upgrading of T-72 Tank

The programme launched to modernise the T-72 M1 Ajeya MBTs is still unsatisfactory and has not progressed much.

About 1,700 T-72 M1s have been manufactured under licence at HVF Avadi. The T-72 M1 modernisation programme under Project Rhino will extend the service life of the MBT by 20 years; enhance their accuracy with new fire control system (FCS) whose trials are under way. This will give night fighting capability through a thermal imager integrated with the tank's FCS. Three hundred T-72 tanks of the Army have been fitted with thermal imaging stand-alone sights (TISAS) while 300 more are in the pipeline bringing the total to 600 TISAS. Thus about 1,000 remaining T-72 tanks will be fitted with more modern integrated fire control systems. However, the overall night fighting capability of India's armour is currently inadequate and operationally unacceptable. The tanks are additionally being equipped with new type of explosive reactive armour (ERA) panels which will provide protection against kinetic energy as well as tandem warhead, chemical energy projectiles for better protection, along with a laser warning system and new radio sets for better and more secure communications. A new power-pack is also under consideration to further enhance mobility, especially with the heavy ERA packages that are being strapped on. An auxiliary power-pack for environmental control and integrated fire detection and suppression system are also being introduced. Gun barrels capable of firing conventional munitions and guided missiles are likely to replace the existing barrels. The modernisation of the T-72 is way behind schedule due to complicated procurement procedures exacerbated by delayed decision-making and in-house disagreements.

The T-90, the improved T-72 M1 tanks and Arjun tanks, will constitute India's armour might in the future till a new MBT is chosen or designed indigenously. Meanwhile, light tanks for the eastern theatre are still being debated.

Mechanised Infantry

The mechanised infantry is currently equipped with the BMP-2 infantry combat vehicle (ICV) named Sarath. Over 1,000 of these have been manufactured since 1987. A new variant is the 81mm carrier mortar tracked that is based on the chassis of the Sarath ICV and has been indigenously developed to enhance the integral firepower available to mechanised infantry battalions. Other variants include a command post, an ambulance, armoured dozer and engineer reconnaissance vehicles. The ICVs are being equipped with thermal imaging night sights and image intensifiers. The Army had ordered 198 carrier mortar tracked vehicle, which have since been delivered. The ICV BMP-2/2K is being modernised by upgrading its existing NBC System, fire detection and suppression system, ERA panels to provide extra protection and a new power-pack. The scheme to fit environmental control for ICV BMP-2 is in an advanced stage of procurement. Additional battlefield surveillance radar (medium-range) mounted on high mobility wheeled vehicles are also being procured.

The Indian Army has planned for a futuristic infantry combat vehicle (FICV) to replace the BMP-2 with key operational and performance parameters envisaged in the Indian context. A project to build 2,600 FICV costing approximately ₹60,000 crore has been approved by the government. This project is a pioneer in 'Make High-Tech' category where for the first time the defence industry has invited participation by private established agencies. ■

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Lethality with Speed for Brown-water Operations

Fast attack craft are small, fast, agile, highly manoeuvrable and normally armed with guns, missiles or rockets or all of these, depending on their role

IAI Super Dvora Mark III

By Lt General (Retd) Naresh Chand

Fast attack craft (FAC) can be called smaller warships which are designed to operate closer to the coast or for brown-water operations. Many navies do not require the capability of a blue-water navy and thus a major fleet of theirs consist of FACs. Examples of this are both the Korean Navies and the Iranian Navy. North Korea uses those against South Korea and Iran has been seen developing “swarm boats” to be used as harassing vessels in the heavily-contested littoral waters of the Persian Gulf. They can also be called fast patrol boats or missile boats, depending on their role. FACs are small, fast, agile, highly manoeuvrable and normally armed with guns, missiles or rockets or all of these, depending on their role. The size also can vary from 50 tonnes to 400 tonnes and can reach speeds of 25-50 knots. The US Navy called it patrol craft fast or swift boat, which was made of aluminium and about a hundred were used for counter-insurgency operations in brown waters, during the Vietnam War. The present US Secretary of State John Kerry (then a Lieutenant) served aboard a swift boat for approximately four of his 16 months served in Vietnam and won the Silver Star, and three Purple Hearts during river-

ine combat. The erstwhile Soviet Union used FACs as missile boats which were armed with anti-ship missiles like the Komar class or the OSA class. The Indian Navy used those very effectively while attacking Karachi during December 1971. Due to these attacks, Pakistan lost almost half its fleet and a large portion of fuel reserves.

The threat around the littorals has become alarming due to the increase in smuggling, piracy, trafficking, terrorism, and fisheries protection and policing. Smuggling can include weapons of mass destruction. Protection of the exclusive economic zone (EEZ) is also an important role. Thus all countries which have a large coastline to protect are investing in some form of FACs. Some countries like the United States, envisaging a global role, are investing in ships/submarines suitable for littoral warfare.

FACs

South Korea: They have robust shipbuilding units which design and manufacture many types of FACs. Hyundai Heavy Industries Limited manufactured HD 500 FAC which weighs 560 tonnes, has a maximum speed of 39 knots and a range of

IAI's Super Dvora MKIII

The Super Dvora class of multi-mission patrol and attack boats are designed for high speed/high endurance platform for a variety of diverse missions of offshore patrol, EEZ control, law enforcement, naval intelligence, command and control, interdiction and boarding of suspect targets. The civil missions could be humanitarian assistance, search and rescue and disaster relief. All Super Dvora class variants are designed to attain and sustain high operating tempos. The design enables stable sea operations at all speeds and a dry deck during high-speed moves and pursuit.

Weapon: The options include Optonic Payload Slaved: 23/25/30mm stabilised cannon; manned Cannon-20/23mm; manned machine guns- 0.5"/7.62mm; 40mm grenade launcher and tactical missiles with a range of six-eight km.

Operational Parameters: They include displacement of 70 tonnes, range of 1,000nm at economic speed and top speed of 45 knots.

Mini Dvora: The Mini Dvora is capable of high manoeuvrability with the ability to operate from the shallowest inlets and beaches to shallow littorals and beyond. The propulsion and steering systems of this class of craft also accommodate extremely shallow draft and beaching operations. •

2,300 knots at 15 knots. Kangnam Corporation has successfully and continually extended its building areas into steel/aluminium hull vessels, such as 500-tonne-class patrol craft and 100-tonne-class fast attack boats.

Singapore: Singapore Technologies Marine Ltd (ST Marine) has built 12 fearless class patrol vessels for the Republic of Singapore Navy (RSN). The first six vessels of the class armed with torpedoes are the A244S, supplied by Whitehead Alenia for anti-submarine warfare missions. The air defence system is the Simbad twin-missile launcher for the Mistral surface-to-air missile, supplied by MBDA. The remaining six vessels are for anti-surface warfare. The patrol vessel's main gun is the Oto Melara 76mm Super Rapide. The patrol vessel is also armed with four CIS 50 12.7mm general-purpose machine guns. The vessels are of 55 metres length.

Russia: The Mirage project 14310 fast patrol boat is designed by the Almaz Central Marine Design Bureau in Saint Petersburg and production is by Vympel Joint Stock Shipbuilding Association. The role of the Mirage fast patrol boat is to carry out protection of territorial waters and EEZ, and to provide support to police, Coast Guard and customs forces.

The vessel is capable of operation in rough seas up to sea state 7 and armed with AK-306 automatic artillery system and eight Igla-1M portable air defence missile systems. The patrol boat also has space for the installation of pedestal mounts for two 14.5mm machine guns together with 1,000 rounds of ammunition, a Shturm missile system with Ataka missiles or the Vikhr missile system with six missiles.

France: The Um Al Maradim class of missile attack craft have been built for Kuwait by Construction Mecaniques de Nor-

mandie (CMN) at their Cherbourg Shipyard. The craft are based on CMN's Combattante I design. CMN's Combattante range of fast attack craft includes the most recent designs—Combattante IM, Combattante V, VII and VIII and Combattante BR70M. The Combattante IM features a new combat system configuration with an unmanned aerial vehicle. The Combattante I FAC for Kuwait is 42 metres long and 8.2 metres wide. The fast attack craft uses a steel hull construction and the full load displacement is 245 tonnes. The attack craft are armed with two twin-launchers for the MBDA Sea Skua surface-to-surface missiles, mounted on the aft deck. The vessel's main gun is Oto Melara 40mm gun and apart from Giat type M621 20mm gun, there are also two 12.7mm general purpose machine guns.

United Kingdom: BAE Systems' 62-metre FAC is designed as a high speed, multi-role platform able to operate in both anti-air and surface combat situations like high speed interception, surveillance, intelligence gathering, patrol, interdiction and engagement of enemy forces. The FAC's design incorporates advanced stealth technology to minimise infrared, radar, magnetic and noise signatures. It has a displacement of 720 tonnes, length of 62 metres, top speed of 36 knots and range of 1,200 km.

Iran: Iran plans to use swarms of small craft to engage opposing forces in 'hit and run attacks' in the confined and crowded waters of the Strait of Hormuz and possibly out into the Gulf of Oman. Iran could coordinate these attacks with salvos of anti-

EIGHTY FAST INTERCEPTION CRAFT ARE REQUIRED FOR THE INDIAN NAVY'S 1,000-STRONG SAGAR PRAHARI BAL, CREATED AFTER THE 2008 MUMBAI TERROR ATTACKS, TO ENHANCE PATROLLING AND INTERCEPTION OPERATIONS

ship cruise missiles and swarms of UAVs launched either from the Iranian shore or from the islands guarding the entrance to the Persian Gulf. To support such a plan, during 2008, Iran acquired 74 indigenous gunboats. Islamic Revolution or Revolutionary Guards' Navy (IRGCN) operates 1,500 boats and fast attack boats. Iran's fleet of missile craft include Chinese-built Thondor (Hudong) class FAC equipped with I-band search and navigation radars and is armed with the C-801 and C-802 anti-ship cruise missiles. Supporting these are small patrol boats equipped with heavy machine guns, grenade launchers, anti-tank-guided weapons and man-portable surface-to-air missiles (SAMS) or just small arms. Recent reports on Iran's small boat programme emphasises on the need to increase speeds from the current norm of 55 knots to speeds of 80-85 knots in future platforms and suitably armed to provide speed and lethality.

Pakistan: Pakistan has FAC Squadron which has a mix of craft from China, Turkey and its own. Azmat class is 560 tonnes missile boat of Chinese origin. Larkana class is the first ever indigenously designed and developed 180-tonne gun boat. Similarly, the Jurrat class is a 250-tonne missile boat. MRTP-33 is a 120-tonne FAC from Turkey.

Israel: India is connected with Israel since 1997 when it acquired two Super Dvora Mark II FACs from Israel Aerospace Industries (IAI) Ramta. The remaining five were built under licence at Goa Shipyard. The Super Dvora Mark II is a high-speed class of patrol boats meant for a variety of naval missions from typical offshore coastal patrol mission profiles to high-speed, high-maneuvre littoral warfare. Super Dvora Mark III is the latest generation of the Dvora family of fast patrol boats or fast attack craft (FPB/FAC), manufactured by IAI Ramta and can be used by the Navy or the Coast Guard.

Indian Perspective

India has about 7,516 km of coastline which has to be constantly guarded, apart from the exclusive economic zone (EEZ). After various coastal threats and especially after 26/11, the government made a special coastal security plan which also included acquiring various types FACs and smaller boats for the Maritime Police, Indian Coast Guard (ICG) and the Indian Navy. Those are:

Indian Navy: Eighty fast interception craft are required for the Indian Navy's 1,000-strong Sagar Prahari Bal, created after the 2008 Mumbai terror attacks, to enhance patrolling and interception operations. The Indian Navy has signed a deal with a Sri Lankan shipyard company for the purpose.

ICG: The MoD had obtained the Cabinet Committee on Security approval for the procurement of 15 interceptor boats for ICG from the Bharati Shipyard Ltd. This requirement is from an earlier projection and the procurement will be completed by March 2014. Apart from these, 50 interceptor boats are also on order, the sixth of which built by Larsen and Toubro (L&T), was launched during August 2013. ABG has also supplied thirteen 26m FIC. Construction of 20 fast patrol boats of 50 metres length, designed by SEDS, Kochi, and being built by the Cochin Shipyard Limited for the ICG is in progress.

Miscellaneous requirement including for the Maritime Police: The infrastructure for the coastal security has been phased in two parts. In the Coastal Security Scheme (CSS) Phase 1, 204 vessels/boats have been procured from the Goa Shipyard Ltd and the Garden Reach Shipbuilders and Engineers. Out of the 204 vessels/boats, there are 120 of 12 tonne and 84 of five tonne. The scheme was completed on March 31, 2011. In CSS Phase II, Procurement of 180 (12 tonne) boats and 10 large vessels for A&N Islands is being carried out centrally by the Ministry of Home Affairs. ■

MKU—Leading the world in ballistic protection

MKU is a leading manufacturer of ballistic protection equipment and night vision devices, with over 25 years of domain experience. The protection solutions offered by MKU include ballistic jackets, armour inserts, helmets, advanced protection gear, platform protection solutions for aircrafts, naval vessels and land vehicles. MKU's latest range of personal protection products include some which are patented in the US and comply with the most stringent and new international standards like NIJ 0101.06.

MKU is also foraying into the area of night vision devices (NVDs). A new range of NVDs manufactured by MKU, GmbH include the Jaguar 7 binoculars, Jaguar 14 monoculars and night eye weapon sight.

MKU has a strong vision of becoming a global leader in the protection and surveillance domain by attaining technological excellence. MKU recognises the value of a soldier, and understands how important it is for them to survive and hence follows a very stringent process to monitor the superiority of their products not only in terms of performance but also its quality. In addition, with a lot of focus and resources in R&D, MKU keeps upgrading their

technology in order to bring more competence in its products, and help the soldiers perform smoothly.

MKU's infrastructure spans two units in India and one in Germany. Units 1 & 2 are located at Malwan and Rooma near Kanpur. Unit 3 is located at Sittensen in Germany. Together, these units have capacities to produce over 2,00,000 helmets, 1,50,000 ballistic jackets and 3,00,000 armour inserts, 72,000 sq metres of armour panels and approximately 6,000 up-armour kits annually. They cover an area of about 2,00,000 sq. ft. and employs over 400 people.

MKU has an in-house ballistic laboratory situated at its off-shore facility in Germany which conforms to testing standards as specified by NIJ 0101.06. MKU recently inaugurated a Technical Research Centre for research and development for new, innovative and versatile solutions in the field of ballistic protection.

MKU spends approximately 4.5 per cent of its total turnover on research and development. In a constant endeavour to remain on the leading edge of technology, the company focuses on innovation as the key to survival of soldiers whom they strive to protect in various threat scenarios. ■



Helmet BF with IPS


 SMART-S Mk2
from Thales

Marine Radars for Safe Navigation at Sea

Radar plots are used to get the information regarding a ship's movement and the risk of collision by giving bearing, range, closest point of approach and other relevant information. Radars are also used for surveillance and fire control. Normally, in modern ships, all the radars, sensors and instruments are integrated to provide a holistic picture of the environment.

By Lt General (Retd) Naresh Chand

Marine radars are primarily used for safe navigation at sea as they can detect objects like ships at sea and also the proximity of landmass. The radars are also used for surveillance and detection for any threat from sea and air. Radar is vital for safety at sea and near the shore. Ship navigators need to be able to guide their ships with very high accuracy in the worst of conditions, including blind navigation. According to International Regulations for Preventing Collisions at Sea of 1972 (Colregs), published by the International Maritime Organisation, all ships have to maintain a proper radar to obtain early warning of risk of collision. Radar plots are used to get the information regarding a ship's movement and the risk of collision by giving bearing, range, closest point of approach and other relevant information. Radars are also used for surveillance and fire control. Normally, in modern ships, all the radars, sensors and instruments are integrated to provide a holistic picture of the environment.

Marine Radar Frequencies: X-and S-band are the two basic radar frequencies which are commonly used in marine radars. X-band is of higher frequency and so has higher resolution and a sharper image, while S-band being at lower frequency is less affected by rain and fog. X-band can be used for fire control of guns and missiles, carry out search, acquire the target, track it, identify the target and then guide the weapon system onto the target for destruction. X-band's higher resolution is particularly effective for target identification and discrimination. X-band radars are small in size and thus mobile and easily transportable. Normally larger vessels have both X-and S-band radars while smaller vessels have only X-band. S-band radars are often used for specialised applications, such as seeing through heavy weather or precipitation and for long-range detection. S-band antennas are also larger in size.

Effect of Marine Environment: Apart from rain, snow, fog and clouds which effect land based radars; marine radars are

affected by the sea surface, high humidity and the roll of the ship due to wave formation. It also has to operate on the move and at times in extreme weather elements. The propagation of radar waves on the surface of the sea is different as compared to free space. All these factors warrant a different technological approach for marine radars.

SOME EXAMPLES OF MARINE RADARS

Saab

Sea Giraffe AMB: Saab's Sea Giraffe AMB is a multi-role medium-range 3D surveillance phased array radar system for naval applications. It can carry out air, surface and fire control roles simultaneously and is thus suitable for all typical naval environments including littoral and blue-water operations. The agile multi-beam function scans the entire search volume to 70 degrees in every single scan with a fast scan-rate of 60 rpm. Its instrument ranges are 40/100/180 km and altitude detection ceiling is more than 20,000 metres.

Raytheon

AN/SPS-73(V)12: AN/SPS-73(V)12 is a short-range, two-dimensional, surface-search/navigation radar system that provides contact range and bearing information. It can track up to 200 targets on a single system or 300 targets on a dual system with speeds up to 210 knots (about 389 km/ph). It is employed with the US Navy and Coast Guard and with many other countries.

Radar Set AN/SPS-49: Radar Set AN/SPS-49 is an L-band, 2D which is used for providing long-range air surveillance in severe clutter and jamming environment. Other functions include air traffic control, air intercept control and anti-submarine aircraft control. In the long-range mode, the AN/SPS-49 can detect small fighter aircraft at ranges in excess of 225 nautical miles (about 416 km).

Air & Missile Defence Radar (AMDR): Consisting of a S-band radar, an X-band radar and a radar suite controller; AMDR significantly increases detection range and adds powerful discrimination accuracy to the US Navy's Arleigh Burke class of destroyers.

Dual Band Radar (DBR): DBR combines the AN/SPY-3 multifunction radar (X-band) and the volume search radar (S-band), coordinated by a single resource manager. The system provides the US Navy's Ford class aircraft carriers (CVN 78) with an unprecedented level of performance and capability to detect and track hostile targets.

Aegis: For 40 years, Raytheon has been the designer and manufacturer for major elements of the Aegis combat system, which provides integrated air and missile defence capabilities. Raytheon produces Aegis' MK99 fire control system and SPY-1(D) illuminator.

Cobra Judy Replacement (CJR): CJR's dual-band radar suite consists of X- and S-band phased-array sensors, a common radar suite controller and other related mission equipment. The system provides long-loiter ballistic missile data collection capability.

Lockheed Martin

AN/SPY-I Radar System: AN/SPY-I radar system is the primary

air and surface radar for the Aegis Combat System installed in the Ticonderoga (CG-47) and Arleigh Burke (DDG-51) class warships. It is a multifunction phased-array radar capable of search, automatic detection, transition to track, tracking of air and surface targets, and missile engagement support. It has a range of 100+ nm (about 180+ km). SPY-1 family of radars has about eight variants to fit in various types of surface ships.

Air and Missile Defence Radar (AMDR): Air and missile defence radar is an advanced solid-state radar suite for naval surface combatants consisting of a digital beam forming S-band radar (AMDR-S), an X-band solid-state radar (AMDR-X) and a radar suite controller (RSC). AMDR will be installed on the US Navy's future Flight III DDG 51 class destroyers. Under a 24-month Technology Development Phase contract, Lockheed Martin is maturing its scalable, low-cost AMDR-S and RSC solution, which will enhance the US Navy's capability against advanced anti-ship and ballistic missile threats.

Airbus Defence & Space

TRS-4D: The German Navy's F125 class frigates are to be fitted with the newly developed TRS-4D naval radar, which will provide them with reconnaissance and surveillance capabilities. TRS-4D enables ships ranging from patrol vessels to frigates to carry out the various detection tasks required of ship-borne,

X-BAND AND S-BAND ARE THE TWO BASIC RADAR FREQUENCIES WHICH ARE COMMONLY USED IN MARINE RADARS.

medium-range radar systems both in the open sea as well as in complex coastal zones with a high target density. TRS-4D is the first surveillance radar to make full use of the advantages of active electronically scanned array (AESA) technology, which is more accurate and faster, and thus can tackle a wider-than-ever scope of targets, e.g. for protection against asymmetric attacks. They are also making this technology competitive for medium-sized surveillance and target acquisition radars. For the F125 frigates, the system will be deployed in a version with four fixed arrays. However, a version with a single, mechanically rotating antenna is also available.

Thales

Active Phased Array multifunction Radar (APAR): APAR is claimed to be the world's first true multifunction radar which counters the modern anti-ship missile threat. APAR can simultaneously support multiple anti-air warfare and anti-surface warfare engagements to guard against saturation attacks. It can carry out automatic detection and tracking of low altitude targets (e.g. sea skimmers), detection and tracking of air targets and the support and guidance of a very wide range of missiles, simultaneously. It is particularly designed to cope with the terminal guidance requirements of SM-2 (Raytheon's Standard Missile is a family of ship-borne medium-range surface-to-air missiles) and Raytheon's Evolved Seasparrow Missile (ESSM missiles). APAR is capable of guiding several missiles simul-

taneously to several threats. Its four arrays cover the full 360 degrees. APAR can operate efficiently in the most adverse conditions. It is operational with the Royal Netherlands Navy and the German Navy. Soon it will be on the patrol ships of the Danish Navy.

SMART-S Mk2: Thales's latest 3D multi beam radar operates in S-band and is optimised for medium- to-long-range surveillance and target designation in littoral environments. SMART-S Mk2 is designed to match the full performance of surface-to-air missiles such as the ESSM. It has two main modes, 250-km range, special helicopter mode, surface fire channels, easy installation, high reliability and easy maintainability.

Short- to medium-range I/K-band radar -Sting EO Mk2: Sting-EO Mk2 is a lightweight dual band (I and K) weapon control system, supports gun fire control which performs kill assessment and makes a valuable contribution to classification and identification of threats. In addition, the system can be used as a surveillance sensor, even under radar silence conditions.

Tracking and Illumination Radar (STIR): STIR is a medium-to-long-range tracking and illumination radar system. The system has been designed primarily to control point and area defence missile systems such as NATO Sea Sparrow, ESSM and Standard Missiles (SM1 and SM2).

Israel Aerospace Industries

ELM-2248 MF-STAR (Multi-function Surveillance and Threat Alert Radar): Incorporating advanced technology and robust system architecture; the MF-STAR employs multi-beam and pulse Doppler techniques as-well-as robust Electronic Counter Counter Measures (ECCM) techniques to extract fast, low RCS targets from complex clutter and jamming environments in blue-water and littoral-warfare support. It is capable of simultaneous multi-engagement support, active and semi-active missile support, 3D long-range air surveillance, 3D medium-range automatic threat alert and many other roles.

ELM-2258 Advanced Lightweight Phased Array (ALPHA) Naval Radar: The radar system provides blue water and littoral warfare support under the toughest target/environment conditions in the existing and future anticipated naval arena. It provides high resolution maritime surface surveillance and tracking, 3D long-range air surveillance and tracking, 3D medium-range automatic threat alert, target classification (including Helo) and gunnery control, and splash spotting.

ELM-2221 - Search, Track and Guidance/Gunnery Radar (STGR): The STGR is capable of tracking highly manoeuvrable targets after quick automatic acquisition, guiding missiles and directing guns against air and surface targets.

Selex ES

KRONOS Multi-function Radar Active (MFRA): KRONOS MFRA is the primary anti-air warfare naval radar for self-defence and local area defence. It undertakes simultaneously a range of tasks, such as medium-long range air surveillance, volumetric search and missile guidance for surface-to-air missiles with very effective ECCM capability, including side lobes blanking, side lobes cancellation, main beam cancellation, track on jammer and burn-through. KRONOS Naval is the naval variant intended for use on ships from 400 tonnes upwards.

RAN-30X: RAN-30X is state-of-the-art X-band 2D surveillance radar. It can operate as a primary sensor for combined surface and air surveillance on-board patrol vessels or as secondary sensor on-board major surface combatants. RAN-30X can carry out a maximum of four operational roles like surface and air surveillance mode, navigation and helicopter control, over-the-horizon detection and anti-sea skimmer missile detection.

Some other Radars of Selex ES

RAN-21S is a 2D air/surface surveillance S-Band radar with a solid-state transmitter for installation on-board medium size ships. The radar can be installed as the primary sensor with a range of up to 120 km. RAN 40L is a 3D long-range, early warning radar which employs a fully solid-state active phased array antenna. RAN 40L ensures detection of aircraft up to 400 km with a minimum range of 180 metres. The main operational functions of RAN 40L include track while scan air/surface long-range surveillance, anti-tactical ballistic missile mode and anti-missile mode. SPN 720 is naval precision approach radar which has been developed in response to the requirements of fast take-off and recovery of aircraft. SPN 730 is low probability of intercept navigation radar, designed to provide excellent detection features combined with silent mission capability.

Indra

ARIES Family of low probability of intercept radars

- Surface search and navigation radar is used as an aid to pilot the ship, detecting all sea surface targets and land masses in the sea, as well as detecting low-flying aircraft.
- **ARIES SAAS** - Air search radar carries out detection and determines ranges and bearing of aircraft as well as providing information for aircraft control or helicopters guidance. When integrated with an IFF, it can provide altitude and identification information.

It is possible to include in single ARIES radar both the capability for air search and the capability for sea surface search and navigation. This way, the radar includes two modes of operation: ARIES SAAS mode and the ARIES NAV mode.

- **ARIES S** - Submarine radar represents a complete radar surveillance and navigation solution for the next generation of submarines. Its low transmission power makes it virtually undetectable by today's tactical ESM systems.
- **ARIES PAR** - Precision approach radar provides for the support of helicopter/aircraft approach and landing manoeuvres and is normally used in conjunction with an ARIES SAAS or another air surveillance radar.

3D LANZA Naval Radar: The LANZA is multi-scenario, multi-threat adaptive radar which combines current technologies with major advances in planar array, solid state amplifiers and signal processing technology. Inherent in the design are excellent performance against stealth protected jammers, enhanced detection in clutter, improved low level performance and tracking capability. Lanza 3D radar has a medium-range (MR) and long-range (LR) version. The radar has 360 degrees coverage in azimuth and a maximum instrumented range of about 112-336 km for MR and 470 km for the LR version. ■

Global Trends & Newer Technologies

The current politico-strategic environment determines not only the nature of conflicts but also influences the format of armed forces world over. The thrust is on development of multi-role helicopter platforms capable of responding to a broader spectrum of missions, while reducing costs related to production, utilisation and maintenance of mixed helicopter fleets.

By Lt General (Retd) B.S. Pawar

Lockheed Martin's
K-Max UAS

Helicopters have been and will continue to be crucial to military operations—this fact has been amply demonstrated since the first major use of helicopters in combat in Vietnam to its current use in combat operations in Afghanistan. Today, the military helicopters have evolved into technologically sophisticated weapon systems, which have to cope with a wide spectrum of threats, some of them bringing them back to the counter-insurgency roots. In this new context, direct fire support of ground forces has superseded airmobile manoeuvres and autonomous helicopter forces—though the helicopters remain essential for their combat and tactical mobility roles. The low intensity conflicts and operations have increased significantly in the last decade, further driving the demand for military helicopters. In both the land and maritime environments, fast moving unconventional and irregular enemy forces pose a very serious and grave threat to a country's security—helicopters are well suited for this role with their inherent characteristics, specially the levitation that they provide in terms of freedom of terrain. In addition, demand for helicopters to rapidly reconfigure for other roles such as medical evacuation and humanitarian/disaster relief operations is expected to increase. The military aviation today is looking at the next generation of military helicopters and the strategy to modernise vertical lift capability for long-term, with improved avionics, electronics, speed, range, reliability and survivability, mission responsiveness and platform versatility. The philosophy is to improve on the present limitations by examining emerging technologies within the realm of the possible. The use of modified Sikorsky Black Hawk helicopters in 'Operation Neptune Spear' has got the industry discuss the use of stealth technology in future military helicopters.

Increasing rationalisation of helicopter fleets and the adoption of one-size-fits-all approach to reduce costs and enhance platform capabilities is today driving the global military helicopter market. Militaries world over especially in the US, UK and France are looking at the multi-role concept involving the development of multi-role platforms. But this concept of one-size-fits-all is not realistic, keeping in mind the distinct requirements of attack and utility/transportation helicopters. Attempts in the past by industry and armed forces to build a single platform combining utility and attack capabilities have not been success-



ful, though the concept of armed helicopters (utility helicopters suitably modified for armament fitment) continues to flourish in most of the militaries—the MH-60 Black Hawks (Velcro Hawks) of the US special forces and closer home our very own armed Dhruv (Rudra) are classic examples in this category. While the distinction between these categories is likely to persist in the coming years, the thrust seems to be towards reducing the number of different platforms within each category. The US Army is already moving in this direction and their joint multi-role fleet vision envisages narrowing down the existing nearly 25 different types of helicopter platforms, spread across the services

to only three basic models, plus a new 'ultra' category extending into the domain of medium-sized fixed-wing transports. The future rotorcraft is not only expected to be larger than the present day conventional helicopters but could be powerful enough to carry their predecessors as external payload. Most militaries today are opting for a multi-role utility helicopter able to perform all essential tactical transport missions on the one hand and a combat helicopter, also multi-role capable of performing all combat missions to include reconnaissance, support and destruction of an extremely wide target selection. The Tigre helicopter is a vivid example of the same, while initially planned in support/protection/anti-tank role, it was subsequently modified for destruction role.

Market Overview

As per global helicopter market forecasts, many of the current military rotorcraft are reaching the end of their operational life, due to which despite budget cuts globally, military helicopter market is expected to grow. Countries such as the United States, Russia, France, Germany, China and India are seeking to replace existing military rotorcraft with state-of-the-art helicopters. In addition to modernising existing fleets, countries are also continuing to focus on acquiring multi-role helicopters/upgrades. The Russian Government's commitment towards procuring 1,000 helicopters for the Russian armed forces, with India expected to go ahead with procurement and delivery of 900 helicopters and the US announcing the potential order of 650 plus MH-60's does point towards positive growth trends in the world military helicopter market. The replacement cycle of the global ageing fleet and growing disposable income in emerging markets are heightening the market demand. The world financial crisis has to some extent considerably downgraded market promises for the next decade, but its impact is likely to be felt more in Europe. Apart from fleet size reduction and increasing research and development spending in renewable energies to cut the overreliance on oil, the current financial context will certainly be the biggest challenge that leading original equipment manufacturers (OEMs) will have to overcome. The immediate consequences affect deeply the volume of scheduled platforms to be delivered, future opportunities and ultimately challenge the competitors' market position. Nevertheless, some leading OEMs have undertaken innovative business strategies to adapt their structures to counter financial instability, such as asset diversification through joint ventures.

Most of the research provisions were planning the end of the fleet replacement cycle by the end of this decade. However, in light of the financial crisis, the researchers expect current procurement to be significantly reduced and delayed, hence postponing the end of the replacement cycle to 2020-25 and deferring prospects in new procurement programmes. Exceptions to this challenge are the Middle East and Asia-Pacific regions, which are for now minimally impacted, although the slowing growth rate in the developing markets of India and China may spell a different outcome by the end of this decade.

The military sector continues to represent the biggest segment within the helicopter market. Any decrease in demand for this sector will be a challenge for the defence industry, requiring the OEMs to adapt their production to a diminishing fleet size

and more intense competition against other OEMs for smaller procurement programmes. Research indicates that in-demand military sectors will increasingly focus on multi-purpose/multi-functional platforms, since this range includes the most versatile and technologically advanced multi-role platforms.

Military Helicopter Competitive Landscape

Considering the market opportunities stated above, Frost & Sullivan market researchers expect traditional leading competitors, such as Bell or Russian Helicopters, to maintain their positions in the global helicopter market. The American OEMs will maintain globally their leadership for the next 10 years, mainly within the military field. Boeing and Sikorsky will have the most significant growth compared to other competitors due to important procurements in India and China. Russian Helicopters growth will remain steady, driven by a strong domestic market demand and procurements in Saudi Arabia, India and China. Other competitors, which include regional OEMs such as the Hindustan Aeronautics Limited and Korean Aerospace Industries, will progressively increase their market share during the forecast period. Similarly, the competitive landscape will witness the growth of Eurocopter, which has established a large distribution and maintenance, repair and overhaul (MRO) network, especially targeting maintenance activities across Latin America, South East Asia, China and India. However, these forecasts could change if the global financial crisis were to get any worse. Apart from a terrible impact on platform volume, this context could benefit state-owned regional competitors, such as the Hindustan Aeronautics Limited, Korean Aerospace Industries, Changhe Aircraft limited, etc. In fact, the leading regional OEMs, which represent almost four per cent of the global market, could significantly strengthen their positions as emerging global competitors. These OEMs are not only benefiting from the market trend in favour of more affordable platforms (based on unit price), they also benefit from the perception of low-cost manufacturing.

Collaborative Approach

In the past ten years, major OEMs have gathered their resources to optimise cost and risk sharing at different levels of the supply chain. Leading American manufacturers like Sikorsky, Bell and Boeing, and niche market company participant AVX Aircraft Company, are working together on the joint multi-role programme. This programme aims to design and produce the next generation of helicopter for the US Army. Such an approach rationalises research and development costs to share core business competencies between manufacturers and ultimately tighten risks for the end users and/or a single industry participant. Similarly, two years after the first successful joint venture (Helivert) to assemble the AW139 helicopter, AgustaWestland and Russian Helicopters are taking a step further by agreeing to jointly develop a new single-engine helicopter. This strategy offers multiple benefits to AgustaWestland, as it is diversifying its financial assets by collaborating with a state-owned company and is gaining new market share across Central Asia, India and China, which are 'Russian Helicopters' traditional privileged markets. On the other hand, the

Russian company is also increasing its network to strengthen its competitive position, gaining certifications and access to previously challenging markets. Russian Helicopters seems to be full throttle behind this strategy, as it also signed several new joint ventures in Asia-Pacific, mainly in China.

This market strategy seems to be the most efficient for both leading and regional competitors, as it provides several benefits for the regional competitors in terms of reducing financial vulnerability, increasing technical know-how, easing conditions of transfer of technologies and ultimately augmenting their market size. Similarly, for the global competitors, it diversifies their skills and financial assets across regions and limits the impact of the financial crisis on their market shares.

Technology Developments

Regrettably, advances in helicopter design have not been as impressive as in the case of fighter aircraft. This despite the fact that helicopters have been utilised in every conflict and the availability of technology to permit generation leaps in helicopter design. It has been rightly stated that while the jet fighters are in their fifth-generation, the rotorcraft industry is still strutting around with first-generation helicopters with only upgrades to its credit. The only difference has been the path-breaking emergence of tilt-rotor technology and the development of the innovative concept of the V-22 Osprey which could generate fresh momentum in the utility/logistics domain. Notwithstanding the above, the new generation helicopter platforms are expected to feature the latest advances in aeronautics, giving military helicopters improved flight performance, especially in relation to speed and stealth. These platforms are also weapon systems that a long process of incremental technological progress is taking to the highest level. The possibilities offered by aero-combat could reach a new milestone through the combined effect of networking and revolutionary doctrinal concepts related to manoeuvre warfare. Conversely, the proliferation of high performance air defence systems could play spoil sport. The technical and technological progress offers the new generation machines unprecedented capabilities—lighter and stronger construction materials, increased autonomy, more powerful engines, reduced acoustic signatures, more accurate navigation systems, enhanced data acquisition and protection systems, and more effective weapons and munitions. Improved reliability and maintainability at lower operating costs is another key area, the industry will have to focus on the future rotorcraft. Helicopters will have to become truly modular, making it possible to change part of the system without affecting overall integrity. The concept of modularity is likely to increase, especially with the emergence of the concept of multi-role machines.

In terms of data acquisition, day/night observation and detection capabilities will increase and become more diversified especially in respect to information sharing and cooperation with other aircraft and unmanned aerial vehicles (UAVs). This aspect has already been incorporated in the Block III Apache model. Target engagement capabilities with regard to weapon range and precision is likely to remain the focus of future development. With sub-conventional operations gaining ascendancy around the world, helicopter survivability will assume greater significance. Advances in stealth, such as

reductions in radar and acoustic signatures offer major results in this area, as does the development of early detection/jamming countermeasure capabilities.

Some of the above technologies are already being incorporated in the development of Eurocopters X2 and X3, and Sikorsky X2 coaxial compound helicopter as technology demonstrators. The main emphasis is on speed, stealth, reliability and survivability. Many of these designs go well beyond the tried and tested rotor and propeller system that has defined generations of helicopter technology since their introduction into the military use in the 1940s. The coaxial rotor design by cutting out the requirement of a tail rotor provides a whole heap of benefits to include more power, greater speeds, stability and noise reduction. In fact, in its demonstrative flight, Sikorsky's X2 achieved a speed of 460 kmph, a major leap from the current standard helicopter speeds. Its military version, the Sikorsky 'S-97 Raider', is stated to be the future light tactical scout helicopter of the US Military. Eurocopter's X3 technology demonstrator is already turning heads by having achieved speeds that are 50 per cent faster than the conventional helicopters with lower vibration levels. The X3 has two propellers on the side of the craft thereby removing the need for a tail rotor and is being projected by Eurocopter for the military's use in search and rescue, Special Forces operations and troop transport. Finally, the tilt-rotor is likely to dominate the future development of vertical lift. The V-22 Osprey deployed in Afghanistan already has thousands of operational flying hours to its credit. AgustaWestland has also come up with a similar rotorcraft, the AW609, the latest player in the emerging tilt-rotor market. Such an aircraft would be ideal for deployment in our north-eastern region where the infrastructure is woefully inadequate. Another area of future development is helicopter UAVs. Two avenues are already being explored and implemented in different countries—UAV-helicopter cooperation and development of rotary-wing UAVs. Lockheed Martin's K-MAX helicopter UAV is currently deployed in Afghanistan for logistic resupply and is proving to be quite a hit. It has been able to fly in adverse weather conditions, when manned helicopters could not fly. Northrop Grumman's Fire Scout is another helicopter UAV which is already in service with the US Navy, capable of operating from ship decks. The Indian military is also seriously examining these unmanned options.

Multi-role Helicopter Platforms

The current politico-strategic environment determines not only the nature of conflicts but also influences the format of armed forces world over. In this scenario, the thrust is on development of multi-role helicopter platforms capable of responding to a broader spectrum of missions, while reducing costs related to production, utilisation and maintenance of mixed helicopter fleets. UAVs will undoubtedly contribute to major advances in air mobility. The UAV can operate as an extension of the helicopter; with the latter taking control of all or part of the UAV's sensors or even the complete UAV. The recent Block-III Apache 64E has this capability. Integration of all modern weapon systems into increasingly sophisticated communication and digitised networks should constitute a major focus in the future development of military helicopters. ■

Precision Shooting with Technology

The US pioneered the long-range precision reconnaissance strike and also realised the importance of short-range precision strike with guided rockets, artillery, mortars and missiles (G-RAMM). The accuracy of these weapons is dependent both on the accuracy of the measurement system used for locating the target and the precision with which the coordinates of the target can be fed into the system.

By Lt General (Retd) Naresh Chand



(Left) Soldiers fire precision-guided Excalibur cannon ammunition;
 (Right) Lockheed Martin's Hellfire missile

Artillery guns initially started with aiming directly at the target but as the gun range increased, firing became indirect, with observers deployed forward to observe the target and direct fire on it. Science of ballistics was developed to evaluate the character the way a gun will fire which also included effects of weather, gravity and natural dispersal of the round. This resulted in the process of 'ranging' on to the target, was actually 'trial and error' method which wasted ammunition and was time consuming. Engaging a moving target by indirect fire was almost impossible. Efforts have been on since World War I to make the engagement of targets from land, sea and air as accurate as possible but technology was still lagging behind. Every weapon system should have mobility, destructive power, range and accuracy. The evolution of precision-guided munitions (PGMs) started with the attempt to combine all these attributes in a single weapon. The current family of PGMs has all this and a lot more.

The normal dispersion of artillery can be around 175 metres at 20 km and 273 metres at 30 km which has been brought down within 50 metres or less. Such accuracy saves ammunition, reduces collateral damage and is more destructive with a very short reaction time. The US pioneered the long-range precision reconnaissance strike and also realised the importance of short-range precision strike with guided rockets, artillery, mortars and missiles (G-RAMM). The accuracy of these weapons is dependent both on the accuracy of the measurement system used for locating the target and the precision with which the coordinates of the target can be fed into the system. There are many guidance technologies like laser, infrared, millimetre wave radar, ladar (light detection and ranging), etc. The guidance can also be provided by inertial guided systems supported by satellites having positioning, navigation and timing (PNT) capabilities like the global positioning system (GPS) of the US. Other countries like Russia, China, Europe and India

XM1156 precision guidance kit

have developed or are in the process of developing such satellite systems.

Guidance Technologies

The Germans were first to introduce PGMs with radio control or wire guidance when they attacked Italian battleship Roma in 1943. The closest the allies developed was the 454 kg AZimuth Only (AZON). The US also tried various guidance systems based on TV, semi-active radar and infrared.

Radio-controlled Weapons

The British tried radio-controlled remotely-guided planes laden with explosive, such as Larynx. The US used similar techniques with Operation Aphrodite with little success. During the Korean War, the US again started trying out electro-optical bomb (or camera bomb) which was equipped with TV and flare sights. The camera gave the location of the target with the help of which the bomb could be steered by the sighting system onto the target. The tube-launched, optically tracked, wire-guided missile system (TOW) is another example of using the wire to transmit signals to guide the missile onto the target. Milan and Malyutka anti-tank missiles are two such examples. The wire was used to transmit the signals as radio could be jammed but the wire limited the range. Raytheon's Maverick AGM-65A anti-tank missile also uses electro-optical guidance system.

Infrared-guided Weapons

Infrared (IR) light is electromagnetic radiation with longer wavelengths than those of visible light and includes most of the thermal radiation emitted by objects near room temperature. Objects generate and retain heat which is visible in the infrared wavelengths of light when compared to objects in the background. Emission of this IR is used to track a target which is called IR guidance and is used for passive guidance of missiles. Such missiles are also called heat seeking missiles. Smaller missiles, especially man-portable air-defence systems normally use IR homing guidance systems which has the advantage of being "fire-and-forget". The US Stinger and Maverick (AGM-65D); Russian SA-18 Iglu and the Chinese FN-6 are some examples of IR guidance.

Laser-guided Weapons

Laser guidance was first applied to aerial bombs to achieve greater accuracy as those were cheaper than employing a guided missile and were first developed in the US and UK in the early 1960s. Some laser-guided systems utilise beam riding guidance, but most operate on semi-active laser homing. In this technique, the target has to be illuminated with laser which then assists the bomb to accurately hit the target. Paveway laser-guided bomb (LGB) of the US was used effectively in Vietnam. The Paveway series continued to be developed and improved in effectiveness and accuracy. The latest in the



series is the GBU-59 Enhanced Paveway II. Other examples are laser homing attack or laser homing anti-tank (LAHAT) of Israel, Maverick AGM-65E anti-tank missile and AGM-114 Hellfire of the US. BAE Systems' advanced precision kill weapon system (APKWS) laser-guided rocket which is under development, are other examples of laser guidance. In beam riding guidance, a laser beam is used by the missile to ride on it for guidance towards the target. Beam riding guidance was introduced during 1990s when low-cost portable laser designators were developed. Laser beam riding is generally used for short-range anti-tank and air defence missiles like the British SAM Starstreak, Swedish SAM RBS 70, Brazilian anti-tank MSS-1.2 and Russian anti-tank 9M119 Svir.

Millimetre-wave Radar

Active radar guidance technology was earlier used for anti-ship and surface attack weapons but later on was integrated into the land attack missiles. Radar seekers can be augmented by other elements such as electro-optical global positioning system (GPS), laser detection and ranging (LADAR), etc. Other applications of millimetre wave radars is to detect and identify and engage armoured vehicles and other high value targets as it provides a very high resolution, all-weather capability and is difficult to jam. In the third generation of anti-tank guided missiles (ATGM), it provides lock-on-before-launch capability. Indian ATGM Nag also uses millimetre wave radar seeker which is under development. Lockheed Martin's AGM-114 Hellfire is an air-to-surface ATGM which also uses millimetre radar as its seeker.

Satellite-guided Weapons

The Gulf War brought out the importance of precision-guided munitions but their employment was degraded by poor visibility. This problem was overcome by satellite-guided weapons which employ GPS and are all-weather systems. As the GPS can be jammed, thus these weapons have inertial navigation as back up. The joint direct attack munition (JDAM) kit has been developed by the US to convert unguided bombs into all-weather guided bombs.

PGMs for the Artillery

M712 Copperhead: M712 Copperhead was the first smart projectile developed for artillery whose accuracy could be measured in centimetres. It was cannon launched with a calibre of 155mm and was guided by a laser-designator onto the target. It had anti-tank capability and due to its accuracy, it was capable of destroying smaller targets at a range of more than six km. Its accuracy was like a direct firing weapon. It was employed successfully for destroying observation and guard posts, and radar installations during Operation Desert Storm. It is heavier and longer than the standard round as it has in addition a guidance and control section. The guidance section contains the seeker head and the electronics assembly. The control section includes the control surfaces which provide limited manoeuvrability during flight. About 20 seconds from the target, the designator operator starts designating the target with the laser designator. The laser emission is then received by the seeker for terminal guidance. The laser guidance can be also be from airborne platforms like helicopters and unmanned aerial vehicles (UAVs). The limitation was that the designator has to be closer to the target to illuminate it and designation for long periods has its own risk.

30F39 Krasnopol: Krasnopol is a Russian 152/155mm calibre projectile which is fin-stabilised and has semi-automatic laser-

LOCKHEED MARTIN'S AGM-114 HELLFIRE IS AN AIR-TO-SURFACE ATGM WHICH ALSO USES MILLIMETRE RADAR AS ITS SEEKER

guidance. The target has to be laser illuminated to be guided. It is very effective against tanks, artillery guns or any small hard targets. India also has this system.

XM1156 Precision Guidance Kit: This is a US Army programme to develop a precision guidance kit (PGK) for 155mm artillery shells. PGK will function like a fuse, provide GPS guidance and control surfaces to correct the flight of the shell. It is screwed into the nose of the projectile like a fuse. It is similar to JDAM tail-kit which converts a dumb bomb to a smart bomb. Its circular error probable (CEP) is less than 30-50 metres which is better than the 260 metres CEP of an unguided 155mm round at a range of 30 kilometres. PGK is a cheaper option as compared to other systems.

XM395 Precision Guided Mortar Munition (PGMM): PGMM is a 120mm guided mortar round which is guided by distributed aperture semi-active laser seeker technology. The system consists of a GPS-guided kit which includes a nose and tail subsystem for manoeuvring the bomb. Its CEP is one metre and is being used in Afghanistan.

M982 Excalibur: Excalibur is a 155mm calibre PGM which has been developed by Raytheon Missile Systems and BAE Systems Bofors. With its extended-range and GPS guidance, it provides accurate, first round, fire-for-effect capability. It can be fired from the US Army howitzer—the Paladin and LW 155 and also from the Swedish Archer 52-calibre weapons system.

Excalibur has a range of approximately 40-57 km depending on configuration, with a CEP of around 5-20 metres. It is claimed that one round of Excalibur can have the effect equal to 10-50 conventional ammunition in effectiveness. Excalibur was very effective in Iraq. An improved version of Excalibur termed Excalibur 1b is being developed by Raytheon which will provide greater range, increased accuracy and less collateral damage. During testing, it has achieved exceptional accuracy, with the majority of the rounds landing within two metres of the target.

Guided multiple launch rocket system (GMLRS): Lockheed Martin has developed a new extended-range GMLRS with a range of more than 70 km which is in service with many countries. The GMLRS XM30 rocket has a combination of GPS and inertial guidance system for guidance with small canards on the rocket nose to enhance accuracy. The US Army began using GMLRS rockets in Iraq in September 2005. The 200-pound warhead proved small enough for the weapon to be employed in urban areas against individual buildings without appreciable collateral damage. Earlier analysis indicates that about 670 GMLRS-U rockets had been fired with 98.6 per cent reliability.

Some Future Trends

The US has been leading in PGMs and is continuously fine-tuning the PGM technology. A few examples are:

Adaptable Navigation Systems (ANS): GPS is very important for PNT to the military but GPS can be easily blocked by jamming, inside buildings, under dense foliage, underwater or underground. ANS attempts to provide GPS-quality PNT to military users even in difficult operational environment through precision inertial navigation systems (PINS) and all source positioning and navigation (ASPN).

Extreme Accuracy Tasked Ordnance (EXACTO) and Counter-Sniper Program (C-Sniper): EXACTO seeks to improve sniper effectiveness and improve own safety of the sniper by providing longer stand-off range (both by day and night), better accuracy and reduced time of target engagement.

Shortwave Infrared (SWIR): SWIR cameras are already in use for imaging and target recognition in starlight conditions but they are now being developed for terminal guidance systems.

Directed Energy Weapons: Directed energy weapons are future PGMs and development efforts of these are on in many countries including India.

Technology is providing what Arjun achieved by sheer concentration and training by firing an arrow into the eye of a rotating fish through its reflection in the water in Mahabharata. PGMs reduce the size of the munitions and quantity required on the target. Excalibur which relies on GPS technology is fire-and-forget. For moving targets, the preference is also for fire-and-forget weapons that have terminal guidance. Cost is a stumbling block in developing countries like India who find the cost exorbitant. Availability of technology is another grey area as advance countries like the US will not part with it and the Defence Research and Development Organisation (DRDO) is finding difficulty in developing an active seeker—the ultimate in precision guidance. The other aspect is their doubtful effectiveness in the mountainous terrain which India found by experience during the Kargil operations. ■

Cyber Threats & Ways to Counter

Absolute cyber defence being a misnomer, there is no other way to defeat cyber attacks and ensure strategic defence other than building adequate deterrence through developing 'stealthy' offensive cyber warfare capabilities

By Lt General (Retd) P.C. Katoch

Cyber warfare can hardly be compartmentalised into the military domain exclusively. Threats from cyberspace cut across the lengths and breadths of a nation targeting not only military installations, military command and control networks, weapon systems, etc, but also the critical infrastructure of the entire nation, bringing the country to a standstill. The Frankenstein of 'cyber security' or rather 'cyber insecurity' is striking fear across the lengths and breadths of the globe. Cyberspace has become a major potential landscape of insecurity, courtesy hackers, phishing, malware, viruses like 'Bing', 'Ghostnet', 'Conficker', 'Stuxnet', Hydraq logic/e-bombs, electromagnetic pulse (EMP) attacks and through malware embedded in both software and hardware including at the development/manufacture stage itself. As 99 per cent of computer parts and bulk telecom equipment is imported ex China and we do not have any testing facilities to check if any malware is embedded, it is a serious threat.

Automated tools like Internet worms exploit vulnerabilities and can continue replicating themselves endlessly from systems to systems. "TigerText" software is the latest concern as the sender can delete all the messages, videos and photographs on a recipient's mobile. It is well acknowledged that critical infrastructures including distribution systems of electric power transmission, water, oil, gas and the like are very much susceptible to cyber attacks. A major vulnerability has emerged in the use of Internet. Without the Internet, Wikileaks would not have managed to propagate such classified information at this massive scale. Penetration of Internet is fast becoming an instrument of exercising operational art. Cyber attacks have emerged as potent threat both in conventional and non-conventional/asymmetric war scenarios. Hacking spearheading cyber attacks and cyber terrorism are daily occurrences. Conventional war can actually be won in the fifth domain even before war is declared. The power to take control/interfere with the adversary's networks not only affects the latter's defence potential but can actually cripple a nation, bringing almost everything to a standstill. Cyber attacks have affected all parts of the globe—from the most advanced to the developing countries. Sectors like power, oil, gas and water may well be the first targets for a serious cyber attack. Whether it is cybercriminals engaged in theft or extortion, or foreign governments preparing sophisticated exploits like Stuxnet, cyber attackers have targeted critical infrastructure. Many of these threats pose



West Point cadets tested their cyber defence skills against veteran hackers from the National Security Agency

harsh new challenges for the industries and IT professionals. Denial-of-service attacks on energy networks have increased and besides extortion attempts, foreign infiltration of networks is reaching staggering levels of success.

It is for such reasons that in China, the People's Liberation Army (PLA) is leading the cyber warfare programme. PLA's Network Warfare Battalion, Electric Warfare (EW) Battalions, Intelligence and Psychological Warfare Battalions have been meshed into the cyber warfare machine. Web Defacement Groups spearheaded by PLA were formed more than a decade back. National level cyber defence exercises and field exercises have been held over the years including simulated attacks on foreign countries like India and have now graduated to 'offensive computer operations and cyber warfare' exercises to rehearse pre-emptive cyber strike. Several Cyber Warfare Units have been formed in China culling manpower from 25,000 software companies. Focused research is being done to take control of national networks of countries like India, Taiwan and Japan. Cyber attacks originating from China, especially the ones integrating information warfare (IW) and electronic warfare (EW),

have definite direction and involvement of Chinese Government and the PLA, attacking and defacing websites of Indian Ministry of External Affairs (MEA), Bhabha Atomic Research Centre (BARC), National Informatics Centre (NIC), Ministry of Defence (MoD), National Security Council (NSC), Federation of Indian Chambers of Commerce and Industry (FICCI), Dalai Lama's office and Indian embassies abroad. Data from Defence Research and Development Organisation (DRDO), Hindustan Aeronautics Limited (HAL), naval dockyards, nuclear installations, military bases, defence headquarters (HQs), Institute for Defence Studies and Analysis (IDSA) and other think tanks has been stolen, the most recent attack coming in December 2013 on the Bharat Sanchar Nigam Limited (BSNL) network. National level cyber offensive plans may not have fully crystallised in China yet but would definitely mature before the end of this decade. Chinese cyber warfare capabilities pose an expanding serious threat to India especially since it is an institutionalised and focused national effort by the Chinese. Penetration, theft, interference, injecting viruses and jamming of our networks, command, control, communications, computers, intelligence information surveillance and reconnaissance (C4I2SR), Army intranet, unmanned aerial vehicle (UAV) data, radio/microwave/cellular/satellite communications/satellite and missile launches/programmes are all possible.

Absolute cyber defence being a misnomer, there is no other way to defeat cyber attacks and ensure strategic defence other than building adequate deterrence through developing 'stealthy' offensive cyber warfare capabilities. The US has adopted an unambiguous Offensive Cyber Warfare Policy. We must do likewise and make 'cyber dominance' an essential component of our war doctrine. If we want to deter adversaries from attacking us in cyberspace then we must have following abilities with respect to our adversaries/potential adversaries: stop them from accessing and using our critical information, systems and services; ability to stealthily extract information from their networks and computers including vulnerabilities, plans and programmes of cyber attack/war, forethought and prior assessment being vital since it only takes 300 milliseconds for a keystroke to travel halfway around the world; ability to penetrate their networks undetected and stealthy insertion of dormant codes, to be activated at opportune time for thwarting cyber attack(s); ability to manipulate and doctor radio transmissions; ability to destroy their computer networks, if and when necessary and; ability to manipulate their perceptions. The cyber security strategy should cater to 'hardening' of our critical infrastructure and establishing active cyber security measures incrementally pan India, duly prioritised.

An important adjunct would be the incorporation of deception measures to lead the adversaries/hackers effectively down the garden path. We not only need to continuously monitor cyberspace, more importantly our cyber security strategy should ensure the government, military, economy, industry, business and citizenry enjoys full benefits of a safe, secure and resilient cyber space. We must cash on the importance of public-private partnership and awareness-raising with respect to cyber security, risk management and risk mitigation, particularly in protecting critical infrastructure, technology paced with IT developments like cloud computing, mobile devices security and the like. At

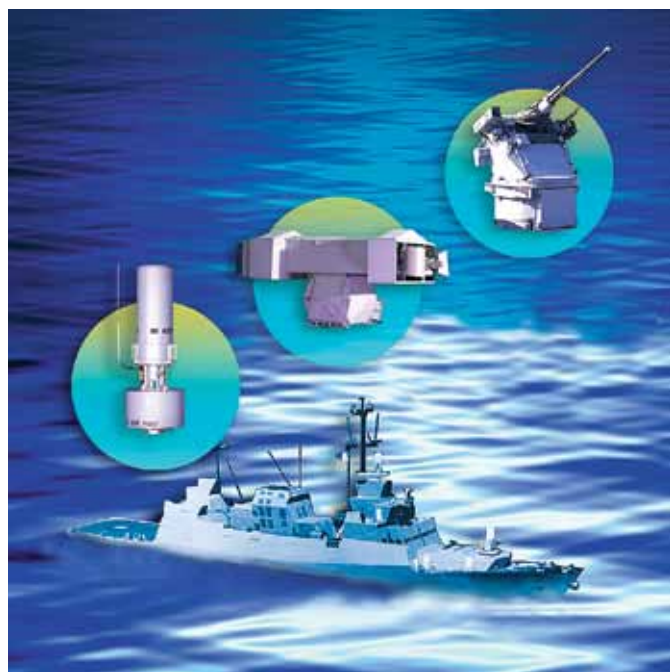
the government level, efforts are already under way to join hands with like-minded nations and allies to collectively address cyber security. Regulating use of cyberspace, building collective safeguards and counterintelligence operations against hackers, need to be accelerated and strengthened.

The Ministry of Defence (MoD), in conjunction with the three services, should holistically review organisational structures to cope with cyber warfare. It should include establishment of a National Cyber Command and a Joint Services Cyber Command/Military Cyber Command. Immediate review of protection of existing data centres and networks is mandated. The services must institute early comprehensive measures to graduate from cyber security to holistic information assurance. A full-fledged Tri-Service Information Assurance Agency needs to be established. An Information Security and Assurance Programme (ISAP) must be developed and tailored to specific organisational mission, goals and objectives. We need a fundamental shift from individual entity to central overview, control and assessment of security measures. Technology, management procedures, cyber laws, organisational structures, cyber security culture, skills and competence of human beings are some of the factors around which cyber security revolves. Such a strategy should be supported with operational organisational structures and a roadmap to develop the necessary cyber security culture.

We are at a nascent stage of developing a policy response to the threats of cyber war. The services have acquired limited forensic capabilities and testing and evaluation laboratories are being established for evaluation of security products and solutions but classification as a certifying authority has hit a dead end with non-availability of scientists and mathematicians, and not permitting any agency below the Scientific Analysis Group to certify products confidential and above classification. It would be prudent to integrate suitable private industry for development and certification of security solutions after administering the oath of secrecy, following the US model. CAIR in any case is outsourcing development of security solutions albeit they do not admit it officially. The Army Cyber Security Establishment (ACSE) with limited capabilities of information assurance—dealing with personnel management and vulnerability management to limited extent but must expand and address configuration management, secure software development management and verification management to cater holistically to 'information assurance'. Bulk of our computer parts and telecommunication equipment being imported, it leaves tremendous scope for embedding malware during the manufacture phase itself. No testing facilities have been created in the country to deal with such situation. This is a serious flaw. Leave aside EMP protection; national data centres like the National Informatics Centre are not even underground. Although, EMP and HPM retro-fitment is a very expensive process, engineering requisite resistance into a system ab-initio adds little to the overall cost but national capacity towards this needs to be created given the incapacitating potential of these weapons. Finally, it is important to track developments elsewhere and keep mapping the related capabilities and weaknesses of our corresponding institutions. ■

Electronic Warfare Strategy on the High Sea

Electronic warfare includes three essential components to include electronic support measures; electronic countermeasures and electronic counter countermeasures. Naval electronic warfare includes systems operating from submarines, ships and airborne platforms, and also includes self-protection systems.



(Left) Surface Electronic Warfare Improvement Programme;
(Below) Vigile LW



By Lt General (Retd) Naresh Chand

Electromagnetic (EM) emission either through radio sets or radar has become an essential component of land, sea and air warfare. The EM spectrum then evolved into providing network-centric operations and use of command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) systems to make the battlefield (including sea and air), more transparent, synergised and providing a faster reaction time. The electronic spectrum also started including infra red (IR), visible, ultraviolet, laser and other portions of the EM spectrum. Warfare strategy then also started including, jamming of the electronic spectrum of the opponent to paralyse operations and thus electronic warfare (EW) was born. EW thus strived to deny the opponent use of electronic spectrum and simultaneously enable the use of electron spectrum by own forces with ease.

EW includes three essential components to include electronic support measures (ESM), also called EW support; electronic countermeasures (ECM), also called electronic attack measures and electronic counter countermeasures (ECCM), also called electronic protection measures. Primarily it implies identifying the opponents location and type of electronic emission (signal intelligence-SIGINT), then protecting own systems from it or jamming them. EW also includes decoys in terms of blips on the screens or flares ejected from a platform.

Naval EW

Naval EW includes systems operating from submarines, ships and airborne platforms, and also includes self-protection systems.

SURFACE SHIPS

Raytheon's Electronic Countermeasures System

AN/SLQ-32(V): The AN/SLQ-32(V) shipboard EW system provides proven electronic support and countermeasure protection for the US and international navies. The system provides full threat band frequency coverage, instantaneous azimuth coverage, 100 per cent probability of intercept and simultaneous response to multiple threats. It can detect aircraft search and target radars well before they detect the ship. The SLQ-32(V) is the principal EW system carried by major US Navy surface ships, with more than 450 systems produced till date. The (V)1 and (V)2 suites are passive, providing early warning, identification and direction finding capability for simultaneous multiple threats. The (V)3 suite provides an additional active response for simultaneous jamming of multiple threats. The (V)4, an expanded version of the (V)3, is used on aircraft carriers. The (V)5 used on destroyers and frigates, integrates a passive (V)2 with an active jammer called "Sidekick." The SLQ-32(V) system has been in operation around the globe since the 1980s, and ongoing efforts to restore and upgrade older systems will extend the life of the SLQ-32(V) well into the 21st century. Raytheon has teamed with Lockheed Martin to compete for the US Navy's surface electronic warfare improvement programme (SEWIP) Block 3 programme. SEWIP Block 3 will upgrade the fleet's capability to electronically attack anti-ship missiles with the AN/SLQ-32(V) electronic warfare system.

SAAB Surface Systems

SME-100: SME-100 is compact, high performance tactical radar ESM system with designated ELINT capabilities which is suitable for installation on all surface platforms. It has a frequency range of 2-18 GHz with 100 per cent probability of interception and accuracy, better than five degrees RMS.

SME-200: SME-200 is a compact, high-performance tactical radar ESM and electronic intelligence (ELINT) system which is suitable for installation on all surface platforms. It has similar

features to SME-100 version but has accuracy better than two degrees RMS.

Thales-Electronic Warfare Systems: Thales provides radar electronic support measures (R-ESM) systems, radar electronic countermeasures (R-ECM systems), decoying systems and complete EW suites developed for the latest platforms like Type 45 Daring class of guided missile destroyers, Horizon class of air-defence destroyers and FREMM frigates. Key EW System (EWS) products include radar electronic support measures (R-ESM, e.g. Vigile), radar electronic countermeasures (R-ECM, e.g. Scorpion 2), active and passive decoy systems and complete EWS suites.

Vigile Light Weight (LW): This is the latest generation of radar ESM system specially designed for small platforms, which provides real-time effective situational awareness and threat warning. It can perform effectively in littoral environments and combined with its low power consumption and compact, light-weight design, it is perfectly suited for small vessels. It has 2-18 GHz instantaneous frequency coverage, 100 per cent probability of interception, pulse-to-pulse 'record and replay' for ELINT and sensitive search mode to detect FM/CW low-probability-of-intercept radar, apart from other features.

Scorpion 2 System: This system provides a cost-effective, advanced radar ECM capability against modern radar threat. It provides electronic attack, point defence and area protection. It is proven at sea capability and in-service with several navies around the world. The system has a frequency range of 7.5 to 18 GHz, low effective radiated power 100 KW (typical) and deception techniques including range gate pull-off, range gate pull-in and false targets apart from other features.

Israel Aerospace Industries, ELTA

ELK-7071N-Naval Communication Intelligence (COMINT)/Direction

Finding (DF) system: This system searches, intercepts, measures, classifies, analyses, locates and monitors ground, airborne and naval communication transmissions with high sensitivity and high probability of interception. Such transmissions are characterised by high mobility, short duration, complex signals and frequent changes in signal parameters, in the densest electromagnetic environments.

ELK-7065 - Naval Conformal HF COMINT/

DF System: Claimed to be the most-"far-looking" sensor on-board the ship, this system uses state-of-the-art DF technologies. It has superior performance in interception, classification, identification,

Cryptologic Technician
(Collection) operating
an SLQ-25 Nixie towed
torpedo decoy



PHOTOGRAPH: US NAVY

DF and monitoring of HF emitters. It has a conformal antenna array with wide frequency coverage without compromising DF performance, while maintaining low radar cross section. Its modular architecture enables tailoring the COMINT/DF system to specific requirements and resources available on-board ship.

Rafael Advance Defense Systems of Israel

Rafael's shipborne integrated electronic warfare (SEWS) DV SEWS-DV is a naval EW suite comprising digital receivers and digital technique generators, optimised to handle very dense electromagnetic environments. Capable of threat identification and simultaneous jamming and deception of multiple threats, the SEWS-DV is designed for both ESM and ECM applications. It is designed to fit on-board all types of ships, including offshore patrol vessels (OPVs), corvettes, frigates and destroyers. Rafael has supplied naval EW systems in various configurations, including complete EW suites, such as SEWS, C-Pearl ESM and Shark-ECM systems to the Israeli Navy and to other navies around the world. The ESM system has a frequency range of 0.5-40 GHz, frequency accuracy of 2 MHz RMS and direction accuracy of 2° RMS. The ECM system has a frequency range of 2-18 GHz and direction accuracy of 2° RMS

SUBMARINES

Saab

Saab's EW solutions include a range of naval laser warning systems and ESM and ELINT systems for submarines providing enhanced detection capabilities, full threat identification and strategic intelligence capabilities in a single cost-effective solution. Based on proven EW technology, the fully integrated solutions provide unrivalled protection for surface vessels and submarines alike in each and every situation.

Naval Laser-warning System (NLWS): Laser activity around a ship can imply a potential threat. NLWS is capable of detecting and analysing lasers in blue-water and littoral combat environments. This system provides vitally important situational awareness to the command team about the presence of laser activity.

UME-100 Tactical ESM/ Designated ELINT: Submarines have to be constantly alert to any threat which is done by detecting and tracking all possible signals emitted around it. The UME-100 is a compact, high performance tactical ESM system with designated ELINT capabilities which can effectively perform this role in a dense signal environment. It has a frequency range of 2-18GHz, with 100 per cent probability of intercept and accuracy better than five degrees RMS.

UME-200 Tactical ESM and Full ELINT: The UME-200 is a compact, high-performance tactical ESM and ELINT system which is an improvement on UME-100 in terms of ELINT but otherwise has the same basic parameters.

SELF-PROTECTION SYSTEMS

Sperry Marine Northrop Grumman

Northrop Grumman's basic acoustic warfare system uses WLR-9/12 to detect torpedo pings, WLR-14 to classify those and submarines sonar to track those, provide automatic alerts and release decoys semi-automatically.

Acoustic Decoys

Acoustic homing and detection systems used for ships are also vulnerable to countermeasures. The US Navy uses Masker and PRopellor AIR Ingestion and Emission (PRAIRIE) systems to create small air bubbles around a ship's hull and wake to reduce sound transmission. Surface ships tow noisemakers like the AN/SLQ-25 Nixie to decoy homing torpedoes by emitting simulated ship noise, such as propeller and engine noise. Larger ships may have two Nixie systems mounted on the rear of the ship to allow operation singularly or in pairs while smaller ships may have only one system. Submarines also deploy similar acoustic device countermeasures to simulate a full size submarine for decoying homing torpedoes.

Sagem

New Generation Dagaie System (NGDS) Self-protection System:

NGDS offers a comprehensive response to new missile threats and protects surface vessels effectively against anti-ship missiles and torpedoes. NGDS is a self-defence EW unit based on decoy launchers. Each system is equipped with a single (for ships under 1,000 tonnes) or dual (for ships over 1,000 tonnes) launcher including decoys (infrared, radar or acoustic) adapted to the threat to be neutralised. NGDS system adapts to all types of munitions: electromagnetic or IR decoys, active off-board decoy (AOD), anti-torpedo decoy and/or laser jammer. The launchers are linked to a computer that selects the decoying best-suited technique. NGDS can set off various anti-missile tactics: centroid seduction, active seduction, dump seduction (with a jammer), confusion dilution or distraction.

Airborne EW Platforms

The US Navy employs dedicated airborne EW platforms like Northrop Grumman's EA-6B Prowler and Boeing's EA-18G Growler.

Northrop Grumman's EA-6B Prowler: This is a dedicated EW aircraft, derived from the A-6 Intruder airframe and has been in service since 1971 for jamming enemy radars and carrying out ELINT. This was the only EW aircraft with the US Navy, US Marine Corps and the US Air Force until Boeing's EA-18G was inducted into service during 2009. EA-6B has long-range, all-weather capability and advanced ECM capability. It has been designed to operate from an aircraft carrier. Its secondary mission is to gather tactical ELINT and targeting enemy radar sites with anti-radiation missiles.

Boeing's EA-18G: Carrier based EA-18G is the cornerstone of the naval airborne electronic attack (AEA) mission which has been derived from Boeing's F/A-18F aircraft. EA-18G incorporates advanced AEA avionics for suppression of enemy air defences (SEAD) and non-traditional electronic attack operations. It carries out SEAD by using both reactive and pre-emptive jamming techniques and is highly effective for stand-off and escort jamming role. EA-18G carries advanced electronically scanned array radar with air-to-air missiles for self-protection. It can also carry out effective target identification and prosecution. The EA-18G's ALQ-218 wideband receiver combined with the ALQ-99 tactical jamming system is effective against any radar-guided surface-to-air threat. ■

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