



# SP's ShowNews



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PUBLISHERS OF SP'S MILITARY YEARBOOK, SP'S AVIATION, SP'S LAND FORCES &amp; SP'S NAVAL FORCES

## DEFENCE EXPENDITURE PART I

# MAPPING INDIA'S MILITARY EFFORTS

by Deba R. Mohanty

India's comprehensive national power has drawn considerable attention in recent times. It has been witnessing a spectacular economic growth rate, especially after the country adopted a liberal economic policy and opened up to the world in the early 1990s. Its socio-economic indicators are improving. Its military modernisation programme has of late caught the attention of many in the region while its strategic ambitions seem to be factored into security calculus of major powers. All indicators of Indian military efforts have shown increasing trends—military expenditure, military R&D, military acquisitions—while accompanying reforms initiated in the higher defence management sector do suggest that India's military power trajectory seems to be in an upward swing, a trend which is likely to grow further in future. This, in turn, will entail significant strategic implications for the region and elsewhere.

If India's strategic aspirations revolve round attainment of a certain degree of strategic autonomy in international affairs, does its 'arms dynamic' (a term used by strategic studies experts, which tries to explore aspects of military efforts by a state in general and its accumulation military hardware in particular to enhance comparable military capability vis-à-vis its adversary) play a role in it? What do trends in India's arms acquisition entail? These are the key questions that are examined here.

### Trends in Military Expenditure

Allocations for national defence for the year 2007-08 have gone up to Rs 96,000 crore (around \$21 billion, in current prices), a rise of 11.4 per cent from the last year's revised expenditure. Allocations for 'Revenue' expenditure account for 56.33 per cent while allocations for 'Capital' expenditure account for 43.67 per cent of the total defence expenditure (TDE). The TDE in turn accounts for 14.08 per cent of the central government expenditure (CGE), less than 8 per cent of the total government expenditure (both central and state governments), and less than 2.1 per cent of the GDP.

Indicative trends for the past one decade suggest that while an average growth in GDP has been pegged at seven per cent, the average ratio of military expenditure to the GDP has been at around 2.2 per cent. An average double-digit growth has been witnessed in military expenditure when calculated in current prices; the same growth has been at slightly more than 4 per cent in real term when calculated in constant prices. Inflation adjusted price as well as escalation of costs at the international arms market could put the real term value of military expenditure further down. Such calculations would put the real value of India's

military expenditure at a reasonably minimum level, although it has increased nominally in recent times.

Trends in India's defence expenditure suggest a few pointers. First, the ratio of defence expenditure to the GDP has remained stagnant at around 2.2 per cent for the past ten years and is not likely to be hiked despite demands coming from high quarters. Second, India's defence expenditure accounts for less than 2 per cent of the global defence expenditure currently estimated to be \$1.12 trillion (Rs 44,39,680 crore) and stands nowhere near big spenders like the US, the UK, France, Germany in the West and countries like China elsewhere. Third, there is a definite trend toward decreasing revenue expenditure while the capital expenditure has witnessed a near three time growth within a span of five years, which otherwise suggest a preference for military hardware modernisation efforts. Fourth, real term increase in India's defence expenditure actually shows a dismal record, if inflation related indicators are taken into account. The real term value of the defence expenditure has indeed declined by around 10 per cent per annum for the past couple of years. Fifth, a large chunk of the funds earmarked for capital expenditure is surrendered year after year. An average of as much as 10 per cent of the budgeted amount for capital acquisition, varying between \$1 billion (Rs 3,964 crore) to \$2 billion (Rs 7,928 crore), remained unspent for the past five years. Even in the current financial year (2006-07), the unspent amount is to the tune of \$700 million (Rs 2,775 crore). And last but not the least, the share of defence R&D budget, which currently stands at around \$1.4 billion (Rs 5,550 crore), accounts for a paltry 6.15 per cent of the total defence budget, while it accounts for around one per cent of the total global investment in military R&D.

### Trends in Weapons Acquisitions

A close look at India's military hardware requirements in contemporary times and medium-term future is important. Last one decade has seen eventual induction/agreed supply through license production or otherwise of big-ticket purchases like Su-30 MKI multi-role fighters, Hawk jet trainers, Kilo-class submarines, Admiral Gorshkov aircraft carrier and T-90 main battle tanks (MBTs). In the last three years, India has signed major multi-billion dollar deals with countries like France, Israel and Russia. These include \$3.6 billion (Rs 14,266 crore) deal for acquisition and eventual construction of six Scorpene, a couple of which are expected to have air independent propulsion features, \$1.5 billion (Rs 5,946 crore) deal to acquire one aircraft carrier, \$4 billion (Rs 15,856 crore) for 66 Hawk jet trainers, and a variety of systems for the land forces, among others. The most recent

Continued on page 2

## SPECIAL GUEST at SP's stall



▲ SP'S EDITOR-IN-CHIEF JAYANT BARANWAL PRESENTS A COPY OF SP'S MILITARY YEARBOOK 2007-2008 TO NAVEEN JINDAL AT THE DEFEXPO ON SUNDAY. THE MP AND INDUSTRIALIST IS ALSO A MEMBER OF THE CONSULTATIVE COMMITTEE ON THE MINISTRY OF DEFENCE.

STORY ON PAGE 6

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**SP GUIDE  
PUBLICATIONS**

## VIGNETTES FROM DAY 2



▲ INDIAN NAVY OFFICIALS RECEIVE A BRIEF ON LOCKHEED MARTIN'S NAVAL CAPABILITIES



◀ HEAD-UP DISPLAY BY ELBIT AT THE SHOW



▲ ONE OF HAL'S EXHIBITS WAS A MODEL OF HAWK BY BAE SYSTEMS IN IAF COLOURS



▲ BOEING'S CHINOOK UNDERLINES ITS DOMINANCE AMONG VARIOUS OTHER SMALL US EXHIBITS IN HALL NO. 14

### Defence Expenditure Part I

*Continued from page 1*

deals/agreements signed with Russia include joint development of Fifth Generation combat aircraft, lease of Akula Class nuclear powered submarines, joint development of medium multi-role transport aircraft (to eventually replace the fleet of AN-32 planes) and 200 plus T-90 MBTs. The Aero-India show at Bangalore in February 2007 has witnessed hectic activities related to aerospace business, reportedly pegged at over \$6 billion (Rs 23,784 crore).

Near future shopping list includes acquisition of 126 medium multi-role combat aircraft (MMRCA) at a cost of \$10.2 billion (Rs 40,425 crore), an array of sophisticated weaponry for the Special Forces, half a dozen warships.

There are also proposals to re-float tenders for 300 medium combat helicopters, another batch of (possibly up to 200) T-90s, more than 1,000 artillery guns and mid-life upgrade of aero-engines for Jaguars and

the Mirage-2000, among others. To such an extent the big-ticket purchases have played a role that in a span of four years, share of capital expenditure in India's total defence expenditure has crossed 40 per cent touch about \$11 billion (Rs 43,593 crore)—a 300 per cent increase since 2002-03. If the capital purchases worth over \$40 billion (Rs 1,58,520 crore) for the 11th defence plan period (2007-2012) and surge in capital expenditure are of any indication, India is likely to become the world's biggest arms market for the next couple of decades.

More allocations for capital purchases for the past few years suggest that hardware elements of India's military modernisation have been given primacy. India's hardware requirements at least for the medium term future (15 to 20 years) are considered quite substantial. Thus, one will not be surprised to witness corresponding increase in capital expenditure for the foreseeable future.

However, the 'unspent' syndrome mostly associ-

ated with the capital purchases must be addressed by the stakeholders of the budgetary rationalisation process: the Ministry of Finance, the Ministry of Defence and the Services Headquarters. Thus, the integrated long-term defence planning must be accorded top priority. The revenue expenditure is witnessing a real term decrease for the past few years, which otherwise suggests a conscious attempt toward much desirable rationalisation of revenue spending.

One will not be surprised if revenue expenditure is further pruned in future. Global trends in force restructuring efforts must be closely examined by India, which otherwise address issues like force manpower planning and rightsizing. India must address these important issues keeping an eye on the changing nature and direction of security situation at local as well as global levels. •

*(To be concluded.)*

*(The author is a Senior Fellow in Security Studies at the Observer Research Foundation, New Delhi.)*





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# "We bring cost advantages & local capabilities"

**Yves Guillaume, CEO, EADS India**

*SP's: Tell us about the company's inception and how EADS and its various subsidiaries have been associated with India.*

**Yves Guillaume (YG):** EADS was created in 2000 by the merger of DaimlerChrysler Aerospace AG (Dasa), Aerospatiale Matra and CASA. EADS looks back on a consistent track record of exceeding its commitments. EADS has achieved numerous notable successes in commercial aviation as well as in its defence business. In 2003, the EADS subsidiary Airbus surpassed its competitor to become number one in its market. Since the company's creation in 2000, EADS doubled the revenues derived from its defence businesses, turning these activities into a growing source of strength for the coming years.

EADS India Private Limited, a 100 per cent owned subsidiary of EADS, was registered in 2006 and is leading the development of the group in India towards an industrial presence through different initiatives at corporate and division level. EADS has had a significant and long standing association with the Indian sub-continent since 1962, when we supplied the first Cheetah & Chetak helicopters, which are still in operation in the Indian Army. This was the start of a long lasting relationship with HAL. In the eighties we had the chance to be part of the first indigenous helicopter program Dhruv, during the initial design stages. Indian Airlines was the launching customer of the first A300 from Airbus back in 1976 and today we are proud to have about 70 per cent market share in the civil aviation industry, with our Airbus & ATR aircraft dominating the Indian skies. Hence our entry into the Indian aerospace industry is as old as 40 years, a testament to the commitment of EADS to the Indian industry.

*SP's: What is the extent, structure and size of representation of EADS in India?*

**YG:** We are present in India with a permanent, dedicated team that represents corporate functions such as international, global sourcing, industrial development; as well as the main Divisions—Airbus, Eurocopter, Space/Astrium and Defence & Security. To increase the efficiency of our actions, these teams have been mobilised in two EADS hubs in Delhi and Bangalore. Our mission is to liaise with both public and private Indian customers, and develop industrial cooperation through sourcing—both toward the primary aim of developing the EADS industrial footprint in India. The Airbus Engineering Centre and Airbus Training Centre were inaugurated in 2007, both located in Bangalore, the IT hub of India. The local divisions of our global business units drive industrialisation and marketing endeavours of the group to further solidify its presence in India.

*SP's: Which are the Indian companies with whom EADS has entered into strategic partnership or there is ongoing dialogue for collaboration? What is your assessment of the strengths and potential of Indian companies?*

**YG:** We are currently discussing strategic alliances for co-development and co-production with several companies in the fields of defence & aerospace. We have created recently a sourcing office whose main objective is to identify capabilities and resources, namely, potential suppliers for our business units, to aid in the development/growth towards internationalisation of the group.

In the private sector, we have projects in aviation and defence. In the public sector we are into Sourcing for Airbus and Eurocopter as well as project cooperation. With BDL, we are currently working on co-development and production for new missile systems for Indian and worldwide markets.

The well known talent pool of engineers is one of India's strengths that we would like to benefit from. The recent liberalization of the A&D industry in India is motivating many Indian companies to compete in these markets thus representing an interesting potential for sourcing and manufacturing of systems and subsystems for our business units. We are very encouraged by the potential for investment and partnership shown by the local Indian industry.

*SP's: What is your long term business strategy in India?*

**YG:** Our long term business strategy is to be seen as a company with an Indian citizenship and at the same time gain cost advantages by increasing our local capabilities. We want to increase our sourcing base in order to support our business units to develop competitive products locally, so that we can have a cost advantage in the international market. We want to address the domestic market as well. This strategy is part of EADS' growth strategy and ties in with our objective to internationalize the group.



*SP's: What is the situation regarding the requirement of Maritime Surveillance aircraft projected by the Indian Navy and your offer of the Airbus A319? What advantages does this have over competitors?*

**YG:** The A319 MPA Long Range Maritime Reconnaissance ASW (LRMRASW) is EADS' answer to the Indian Navy's requirement of maritime Patrol (MPA)/Anti-Submarine- Anti-Surface Warfare aircraft. It is a state-of-the-art proposal with very high local content, including Transfer of Technology that will enable the navy to have a strong deep-sea capability.

We were invited to submit a proposal for eight LRMRASW aircraft to which we replied in May 2006 with our A319 MPA on offer.

After successful technical evaluations and trials we were found to be compliant and were invited for price opening & were found to be the lowest bidder. We expect the Defence Ministry to revert to us soon.

*SP's: Is EADS participating in India's Space programme? If so, to what extent?*

**YG:** Astrium and ISRO have a long lasting relationship starting with the delivery of satellite components, followed by testing equipment for satellite antennas. In 2005, at Le Bourget, Astrium and Antrix, the commercial arm of ISRO, signed an agreement for the commercialization of communication satellites, based on ISRO's INSAT satellite platform and a European communication payload, with components coming from Tesat Spacecom GmbH.

This agreement allowed Astrium to compete in the 2-3 ton class communication satellite market, which is extremely price-sensitive. Shortly after the signature of the agreement, two contracts could be secured: one with Europe's biggest operator Eutelsat (W2M Satellite) and another with the English operator Avanti Systems (Hylas Satellite).

Due to our resident teams within ISRO as well as the intensive interaction between both organizations, Astrium is today the preferred industrial partner for Space. Further cooperation potential lies with the coming together of space agencies on manned missions.

*SP's: Can you give a glimpse of some of the success stories of EADS and its subsidiaries in India?*

**YG:** EADS is a major supplier to the booming Indian commercial aviation sector. Most of the fast-growing private airlines and the state-owned Air India (newly merged with Indian Airlines) have selected Airbus and ATR to develop their fleet. In the past two years, Airbus and ATR have received orders from Air India, Air Deccan, Kingfisher, IndiGo, Jet Airways, GoAir and Flyington Freighters. An example of our success is the fact that a new airline like Kingfisher has chosen us to represent its fleet. Unfortunately infrastructure has not been able to catch up with growth of traffic and large volumes of delivery. With the maiden flight of the Kingfisher A380 scheduled for 2009 another major milestone in India for the company is right ahead.

Eurocopter has secured a market share of about 50 per cent for commercial and parapublic helicopters. Renowned for its versatility and constantly evolving technology, the Ecureuil/Fennec family has delivered over 4,000 helicopters and is employed in a broad range of missions, thanks to its exceptional performances, brilliantly demonstrated by being the only one helicopter in the world that succeeded landing on Mount Everest. It is perfectly positioned for the Indian defence market. We have a successful instance of industrial cooperation in the area of space, with our alliance between ISRO/Antrix and Astrium. Every INSAT satellite belonging to ISRO has been put into orbit from the Ariane launcher.

For the time being, we are pursuing many defence programmes and investing heavily in the defence offset process. We believe that with the opening of the markets to private industries, and with a fair and transparent acquisition process in place, our successes would be manifested very soon. •

## by the way...

Israel's IAI pavilion at Defexpo—the second-largest exhibitor at the show—witnessed the Israeli traditional blessing ceremony, the 'Mitzvot' on Sunday morning in the presence of Israel's Ambassador to India, its Director General of the Ministry of Defence, Israel's Defence Attache to India, the head of IAI and other top officials. Expressing pride, the Ambassador said, "The high levels of defence technology capabilities we have achieved despite the troubles and travails of the past 60 years is a source of great pride for us."



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## 25 Russian companies at Defexpo this year

Russia is a regular participant in Defexpo India. Since the first ever Defexpo 1999, the Russian arms exporters have been seeking to actively use this important platform to promote the achievements of the domestic defense industry. The exposition totaling 400 sq. m, organized by Rosoboronexport, encompasses full-scale hardware, models, mock-ups, posters, reference and promotional materials on over 550 export defense and dual-use products targeted to meet the needs of India and other South Asian and Asia Pacific countries. The Land Forces section is the most saturated one and displays both modern and upgraded versions of armored vehicles, missile and artillery systems, fire control systems, radar reconnaissance and engineering equipment, all-service and special small arms, optical and electro-optical devices. Foreign customers may get acquainted with the T-90S MBT, which entered service with the Indian Land Forces within the framework of the Russian-Indian military-technical cooperation, upgrading variants for the Indian T-72 MBTs and BMP-2 IFVs. Russia's proposals on T-72 upgrading feature several technological 'know-hows' like an advanced fire control system, a new explosive reactive armor system, and a special aerosol screen-laying system. The range of the exhibited defense products for the Land Forces also includes self-propelled artillery guns and howitzers, antitank missile and missile/gun air defense systems, small arms and close-in weapons.

Emphasis is on the Smerch and Grad multiple rocket launcher (MRL) systems and to a wide range of artillery rockets for them. Being the most powerful and cost-effective means for neutralization of the enemy forces at 20 to 90 km, these systems are in demand worldwide. The Smerch MRL system has successfully undergone qualification tests in India and substantiated its unique combat characteristics. In view of the growing role and importance of artillery fire control automation, the Russian exposition contains detailed information on the Kapustnik-B and Mashina-M automated fire control systems. •

## 'Indian armed forces deserve the best'

—Naveen Jindal, Member of Consultative Committee on MoD



▲ NAVEEN JINDAL WRITES HIS COMMENTS IN THE SP'S AUTOGRAPH BOOK AS EDITOR-IN-CHIEF JAYANT BARANWAL LOOKS ON; (BELOW) THE MP INTERACTS WITH MEMBERS OF THE SP'S TEAM

Naveen Jindal, Member of Parliament (MP), visited SP Guide Publications cote Sunday morning and evinced keen interest in the publications. Even as he expressed his appreciation for the product mix brought out by SP Guide Publications, the charismatic Jindal went on to interact with the team members of the publishing house, and made a few interesting, pithy and pointed observations related to the ongoing Defexpo. Jindal expressed his concern at the quality of weapons that the Indian armed forces are equipped with. "The quality of weapons produced indigenously are of poor quality and lack finish," Jindal observed. He added that the Indian armed forces deserve the best and all efforts should be made in this direction. •

—by Lt General (Retd) Naresh Chand



## Rafael, BEL agree on strategic JV

Bharat Electronics Limited (BEL) Bangalore, India and Rafael Advanced Defense Systems Ltd, Haifa, Israel, signed a term sheet that will lead to the formation of a strategic JV. The JV will encourage indigenous advanced technology capabilities of missile electronics and guidance technologies within India and will enable Rafael to meet offset requirements by transferring valuable technologies and workshare to the JV. V.V.R. Sastry, CMD of BEL said, "Rafael is well-known in the international defense community, including its state-of-the-art missile systems. Setting up the JV will enable BEL to expand its portfolio to meet the growing demand of missile electronics."

**About Rafael:** Rafael designs, develops, manufactures and supplies a wide range of advanced defense systems. These leading edge products include naval, air and ground precision weapons, electro-optic systems, electronic warfare (EW) systems, C4I and unmanned systems, acoustic defense systems, armored protection, breaching munitions and space technologies.

**About BEL:** Bharat Electronics Limited (BEL) was established at Bangalore, India, by the Government of India under the Ministry of Defence in 1954 to meet



the specialized electronic needs of the Indian defence services. Over the years, it has grown into a multi-product, multi-technology, multi-unit company serving the needs of customers in diverse fields in India and abroad. •



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▲ BO THORN, PRESIDENT, SWEDISH MAJOR FFV ORDNANCE, MANUFACTURER OF THE RENOWNED CARL GUSTAF, WATCHES THE BALL ZOOM ACROSS THE SKY



▲ INDIAN NAVAL CHIEF ADMIRAL SUREESH MEHTA TAKES A SHOT WHILE RICHARD KIRKLAND OF LOCKHEED MARTIN (CENTRE) AND LIEUTENANT GENERAL S.S. MEHTA OF CII LOOK ON



▲ KIRKLAND AND THE INDIAN NAVY CHIEF DISCUSS THE BEST POSSIBLE STRATEGY



▲ SUSAN A. MARAGHY, VP, STRATEGIC MARKET DEVELOPMENT, LOCKHEED MARTIN IN ACTION

## ROMANCING THE GREENS



▲ BRUNO BOULNOIS OF EUROCOPTER POSES FOR SHUTTERBUGS

### LOCKHEED MARTIN grabs the spotlight

Sunday saw the giants of the global defence industry and distinguished service personnel take a break from taxing business matters to indulge in a different ball game at the Army Golf Course in Delhi. "The good weather and relaxed atmosphere had everybody in jovial moods," said Colonel Jagmohan Singh of Lockheed Martin that sponsored the event coinciding with Defexpo India 2008. Incidentally, the company also flaunts the largest stall at the venue in Pragati Maidan.

The Army Golf Course was founded in 1966 by the then Chief of the Army Staff General P.P. Kumaramangalam, DSO. Keeping in mind the growing interest in the game and increase in membership, the course was re-designed and modernised in 1994. It is now a full fledged 18-hole, PAR 72 championship course with SSS rating of 71.5. Over the years, the Army Golf Course has been considered among the premier golf courses of the country. *The Golf Digest*, published by the New York Times Group, had ranked the AGC as eighth among the 140 golf courses in India.



▲ BO THORN IS ALL SMILES AFTER DISPLAYING A WINNING STREAK



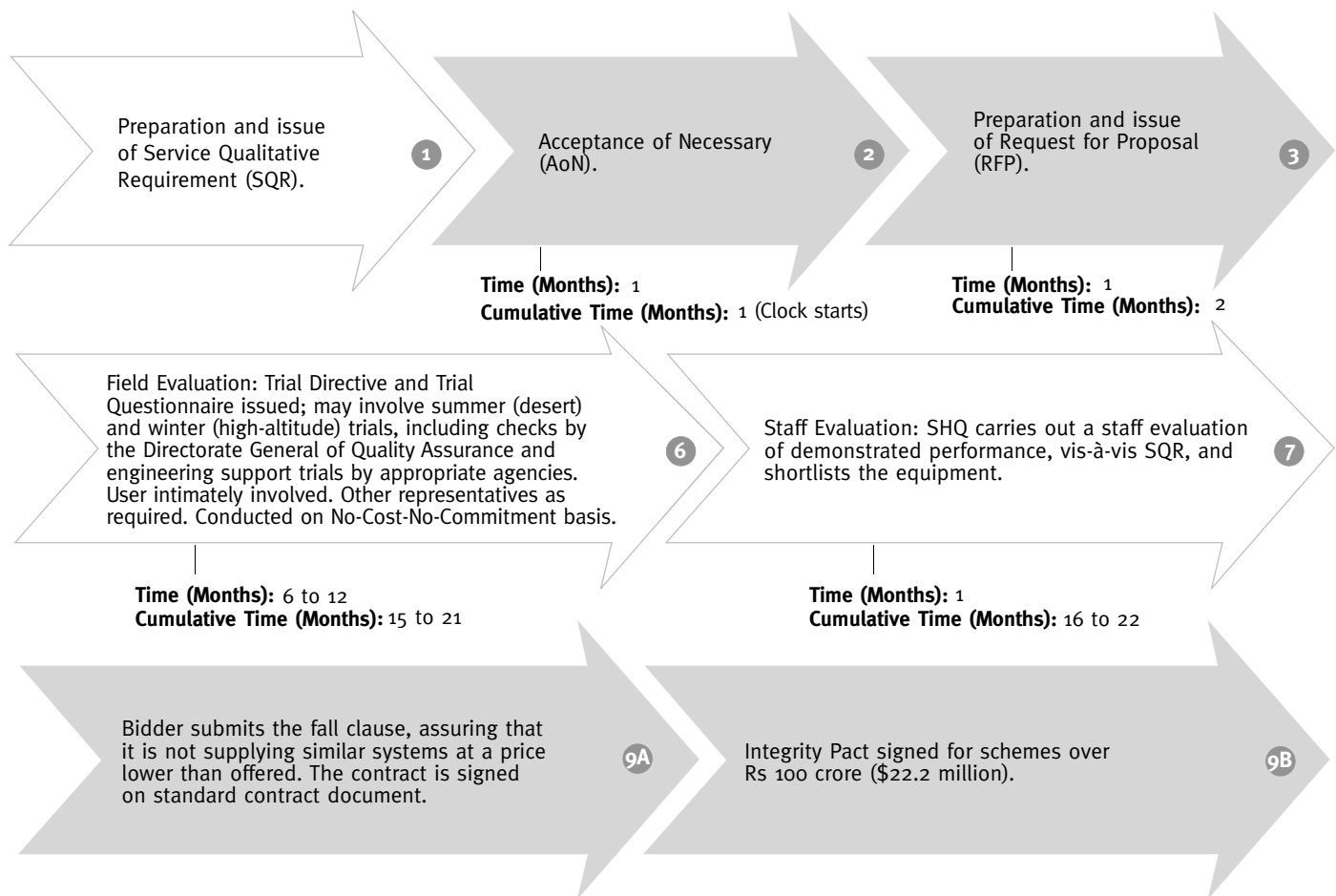


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**Note:**

- To be read in conjunction with DPP 2006.
- Offset activities are carried out concurrently.
- The acquisition process takes 2 to 3 years, including trials.
- MoD: Ministry of Defence
- SHQ: Service Headquarters

MoD SHQ MoD & SHQ

## SP'S at DEFEXPO INDIA 2008

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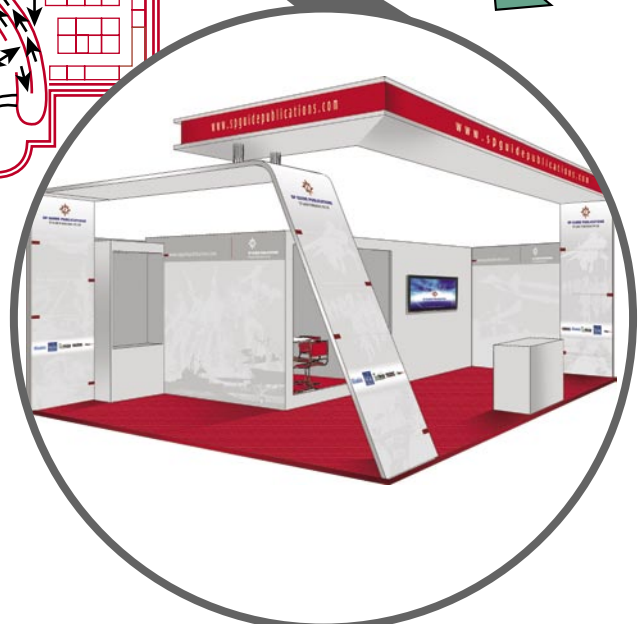
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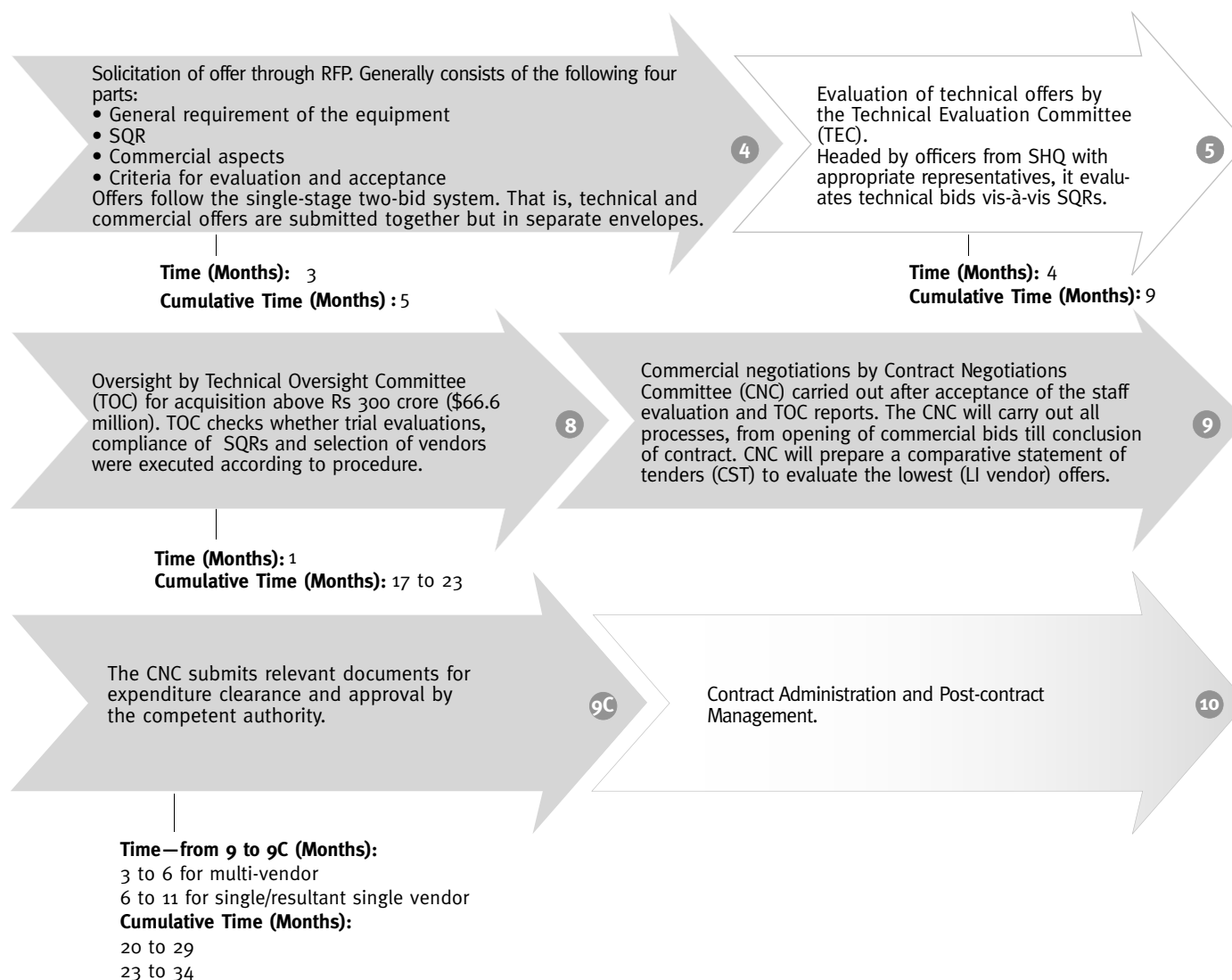


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## CALENDAR OF EVENTS

Monday, 18 February 2007		Tuesday, 19 February 2007	
1000–1800 Hrs	Defexpo India 2008 opened to Business Visitors and Official Delegations	1000–1800 Hrs	Defexpo India 2008 opened to Business Visitors and Official Delegations
1000–1730 Hrs	Press Conferences by Exhibitors at the Press Conference Hall, Pragati Maidan, New Delhi	1000–1730 Hrs	Press Conferences by Exhibitors at the Press Conference Hall, Pragati Maidan, New Delhi
1000–1200 Hrs	Defence Technology Forum 1 - Arms & Ammunition at Ball Room, Phoolwari Restaurant, Pragati Maidan, New Delhi.	1000–1530 Hrs	One to One business meetings, Pragati Maidan, New Delhi
1000–1200 Hrs	Defence Technology Forum 2 – Sighting Equipment (NVDs) at Alta Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi.	1000–1200 Hrs	Defence Technology Forum 9 – Simulators for Military Training at Ball Room, Phoolwari Restaurant, Pragati Maidan, New Delhi.
1000–1200 Hrs	Defence Technology Forum 3 – Helicopters at Evenza Hall at Phoolwari Restaurant, Pragati Maidan, New Delhi.	1000–1200 Hrs	Defence Technology Forum 10 – Warship Design and Production at Alta Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi
1000–1200 Hrs	Defence Technology Forum 4 Wheeled and Track Vehicles at Hall 8, Conference Hall, Pragati Maidan, New Delhi.	1000–1200 Hrs	Defence Technology Forum 11 – Naval Armaments at Evenza Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi.
1400–1600 Hrs	Defence Technology Forum 5 – Military Engineering at Ball Room, Phoolwari Restaurant, Pragati Maidan, New Delhi.	1000–1200 Hrs	Defence Technology Forum 12 – Defence Communications at Hall 8, Conference Hall, Pragati Maidan, New Delhi.
1400–1600 Hrs	Defence Technology Forum 6 – Artillery Technology at Alta Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi.	1400–1600 Hrs	Defence Technology Forum 13 – Surveillance Systems and UAVs at Ball Room, Phoolwari Restaurant, Pragati Maidan, New Delhi
1400–1600 Hrs	Defence Technology Forum 7 – NBC Protection Equipment / Systems at Evenza Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi	1400–1600 Hrs	Defence Technology Forum 14 – Submarine and Underwater Technologies at Alta Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi
1400–1600 Hrs	Defence Technology Forum 8 – Battlefield Management System at Hall 8, Conference Hall, Pragati Maidan, New Delhi.	1400–1600 Hrs	Defence Technology Forum 15 – Fire Control Systems at Evenza Hall, Phoolwari Restaurant, Pragati Maidan, New Delhi
		1400–1530 Hrs	Defence Technology Forum 16 – Missile and Missile Launchers at Hall 8, Conference Hall, Pragati Maidan, New Delhi.
		1600–1730 Hrs	Defexpo Valedictory Session and Prize Distribution Ceremony

**Note:** The above calendar is tentative. Speakers and Session Chairmen to be invited subject to approval of the Ministry of Defence.

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# Boeing trumps up new technologies for Apaches

The company's offer of more advanced solutions for Apache operators around the world could also enable India's Defence Forces acquire a lethal and futuristic helicopter platform

Continuous improvement of the Apache Longbow is essential to maintaining Apache relevance and effectiveness in the future, feel Apache operators around the world. Boeing continues to define these needs and develop solutions for inducting new technologies into the Apache Extended Block III upgrade program.

Some of these solutions include an advanced crew station that offers improved situational awareness. Enhancements that reduce crew workload and new technologies to improve air vehicle performance are the other kinds of solutions.

These solutions can provide India's Defence Forces with a new attack helicopter platform, which would remain relevant well into the 21st century.

"Apache Longbow is a perfect example of an integrated system that has continued to evolve and improve over the years," said Larry Plaster, manager of Apache Modernization Programs at The Boeing Company. "We are focused on continued success that meets our customers' needs for decades to come."

Plaster added, "The Apache Longbow is an outstanding helicopter. Recent demonstrations of new technologies being incorporated by the Block III upgrade program confirm that the Block III Apache will be effective as the army continues to transition to a fully networked Future Force. The Apache will continue to be enhanced to address the operational needs of all Apache customers worldwide."

Improving the Apache's crew station environment by presenting information in a more precise and easily actionable format is vital in the information-rich, network-centric operations (NCO) environment of the future.

## Key Technologies

Some of the key technologies with the potential to address present and future needs include:

- Advanced heads down and heads up display systems
- Advanced sensor and data fusion
- Advanced Cognitive Decision Aiding Systems (CDAS)

Boeing also has developed an Advanced Rotorcraft-Rapid Prototyping Mission Simulator to integrate and evaluate new displays (including full visor helmet displays), new CDAS behaviors, and other new efficient technologies such as Voice Command and Control.

In addition to the Advanced Crew Station work, Boeing and the U.S. Army continue to evaluate the potential for advanced, more capable sensors to improve crew situational awareness including such technologies as distributed aperture sensor fusion and enhanced/synthetic vision systems, which would allow the crew to "see" threats and hostile forces as well as friendly ground troop activity over a very wide field of view around the aircraft – even in heavily obscured visual conditions.

Reduced crew workload is another key component in enabling the Apache Longbow crew of the future to function effectively on the NCO battlefield and execute critical flight maneuvers in the heat of the battle. Boeing is working with the U.S. Army on several technology upgrades that will dramatically reduce crew work-

load and improve crew survivability when implemented. Future enhancements include:

- Modernized Control Laws to improve the low-speed handling characteristics of the current limited-authority Stability Augmentation System
- Helicopter Active Control Technology to allow crews to know when they are approaching an aircraft limit without monitoring the Multi-Purpose Display indicators during high-workload operations
- Fly-By-Wire capability to provide a full authority flight control system for the Apache
- Terrain Avoidance Warning System for integration into the Apache as an aid to prevent controlled-flight-into-terrain accidents. This technology has the potential to significantly improve crew safety and survivability in a high workload environment – especially for operations in obscured visual conditions

## Compatibility to Indian Conditions



▲ THE APACHE LONGBOW

Improved Air Vehicle Performance in on-going operations around the globe emphasizes the need for greater Apache payload, range and operational envelope capabilities – especially in the hot temperature, high altitude environments like India. Block III technologies offer a significant improvement in the aircraft's performance. Boeing is developing several new technologies with the potential to decrease the current weight of the Apache Longbow or increase the power available to lift more weight. Enhancements include:

- The Composite Aft Fuselage prototype design constructed of advanced ballistic tolerant, battlefield reparable composite material to reduce weight. The tailboom, vertical and horizontal stabilizers combine to produce a composite aft fuselage for the Apache that weighs ap-

proximately 90 pounds less than the current metal fuselage. In addition to the significant performance improvement, this technology eliminates the life-limiting components of the fuselage to extend fuselage life for the global Apache fleet

- An upgraded Tail Rotor Drive System including development of a new tail rotor blade developed by Boeing and the U.S. Army to leverage Block III performance improvements along with engine, main transmission and main rotor blade upgrades.

Deliveries to the U.S. Army and Greece, Israel, Japan and Kuwait in 2007 conveyed the clear message that the Apache is achieving milestones and moving toward future success.

"The Apache remains relevant around the world and we hope will some day also provide India with the most lethal, maneuverable, sustainable, and survivable combat helicopter in the world," said Al Winn, Boeing vice president of Apache programs. •



# UNMANNED & UNPARALLELED

## Technology advancements boost UAV role

The earliest known Unmanned Aerial Vehicle (UAV) was A.M. Low's "Aerial Target" of 1916. A number of remote-controlled airplane advances followed, including the Hewitt-Sperry Automatic Airplane, during and post World War I. More were made in the technology rush during the Second World War to train anti-aircraft gunners and to fly attack missions. Teledyne Ryan Firebee I of 1951 and Model 1001 for the US Navy in 1955 were some of the earlier examples but they were a little more than remote controlled airplanes until the Vietnam Era. With the advancements in technology their role expanded to reconnaissance, surveillance, target acquisition and much more to include combat missions. Military applications of UAVs can be broadly summarised as follows:

- Intelligence, surveillance and reconnaissance (ISR); and reconnaissance, surveil-

lance and target acquisition (RSTA) using a combination of electro-optical sensors like infrared, thermal imagers, optical sights, CCD camera, laser, synthetic aperture radar and communications relay packages. Other payloads which can enhance the ISR/RSTA performance are signals intelligence sensors, hyperspectral sensors; and measurement and signature sensors.

- Search and rescue as amply displayed during Tsunami search operations in Andaman and Nicobar Islands. The same is applicable for flooded and avalanche prone areas. The UAV can even home in on an emergency beacon and drop a line when overhead.
- It could carry a common data link and serve as a radio/data relay platform.
- Can enable a leap forward in payload sensor capability for increased target acquisition capability.
- Provide real-time battle damage assessment.

*Continued on page 16*

## NY's Ultralife Batteries sets up unit in India

Ultralife Batteries, Inc., headquartered in New York State, supplier of Lithium, Smart Batteries and Chargers has registered a company with the Indian government for the manufacture of Lithium Batteries in India. The name of the new company to be located in Bangalore is Ultralife India Private Limited.

Ultralife makes and supplies to several militaries around the world, including, US, UK, Germany, India, Israel, Canada, Mexico, New Zealand, etc., a variety of Lithium Rechargeable and Non-rechargeable batteries for land, air and sea mission critical, training and back up power applications. Ultralife has been supplying various military subcontractors in India for the past 4 years with Lithium batteries. Ultralife India will be able to expand its manufacturing and design services at a localized level in India through this new company set up. The JV set up is a demonstration of Ultralife's commitment to partnership with the Indian military through local manufacturing, design and long term support. The facility in Bangalore will design and build customized batteries to customer specifications and has engaged a marketing partner, Team Technology, in Bangalore.

### by the way...

Reflecting Czech efforts to explore and identify opportunities in the Indian defence industry, the Association of Defence Industry of the Czech Republic has several participants at Defexpo '08, including companies like CLS, Explosia, Omnipol, PS and TTC.

## SP'S MILITARY YEARBOOK

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Editor-in-Chief  
**Jayant Baranwal**



## 'ABM capability desirable, cost under scanner'

Air Chief Marshal Fali Homi Major took over as Chief of the Air Staff on April 1, 2007

**SP's:** *What is your vision for the IAF and what are your key result areas?*

**CAS:** Vision for the IAF does not change with the chief. The direction in which the IAF is heading is in conformity with our strategic plans. My vision, therefore, cannot be any different. The IAF vision, in turn, has been harmonised with the vision of the nation. With India emerging as a global economic power, it is necessary that the IAF enhance its capability to fulfill new responsibilities. Preserving the sovereignty of our airspace and maintenance of peace along our borders are of prime importance. However, equally important are trade and energy security to sustain economic growth. To meet the new security challenges, the IAF needs 'strategic reach'. There is a necessity to build up our strategic assets. The key result areas I have laid down for operations, maintenance and administration are manifold, formulated to ensure that the IAF moves steadily towards the status of an 'Aerospace Power'.

**SP's:** *Attaining 'strategic reach', all-weather precision attack and network centric warfare capabilities have been the hallmark of IAF's vision. How far has it progressed in this regard?*

**CAS:** In view of India's growing strategic boundaries and the protection of its interests, the IAF requires a sizeable fleet of multi-mission aerial refueling capable fighter, helicopter and transport aircraft and a strong air defence network. We need to build our space and reconnaissance assets to obtain very accurate, near real-time pictures of the battle space. Some of these capabilities are already available. Many of our fighters now have in-flight refueling capability and we are a 'trans-oceanic' air force. Improved surveillance is also around the corner, with the Aerostats, AWACS and new radars.

**SP's:** *The downslide in the IAF's combat squadrons' strength seems to be continuing unabated. What steps are being taken to reverse the trend?*

**CAS:** The IAF's plan to acquire combat squadrons has been adversely affected due to delay in procurement programmes primarily on account of paucity of resources. The procurement process has not been able to keep pace with phasing out of aircraft types on completion of life. The IAF has plans to induct additional Su-30 MKI. Induction of 126 Medium Multi-Role Combat Aircraft (MMRCA) and the Light Combat Aircraft are expected to arrest the dwindling combat squadron strength and reverse the trend. Our aim is to build the strength by 2020-2025.

*Notes from the Editor:*

- The RFP for acquiring 126 MMRCA has been issued to six contenders from the US, France, Eurofighter European Consortium, Sweden and Russia.
- Order for 40 additional Su-30 MKI has been placed for licence-production by Hindustan Aeronautics Limited
- The indigenous LCA programme is progressing albeit at a slow pace and the

aircraft is unlikely to see squadron service in the IAF before 2012.

- India and Russia have signed an agreement to jointly develop and produce the PAK-FA Fifth Generation fighter.

**SP's:** *Another area of concern for the IAF has been the obsolescence of its air defence (AD) equipment. What is being done to replace or rejuvenate the ageing systems?*

**CAS:** The IAF is in the process of acquiring radars in various categories to meet all AD requirements. Two Aerostat Systems have been procured and installed. Induction of AWACS next year will significantly enhance our AD capability. Regarding SAGW, a two-pronged strategy is in place—upgrade of the existing systems and procurement of new modern AD systems. We have initiated a case for procurement of 'Medium Power Radars' and 'Low Level Transportable Radars' to meet the requirement arising out of obsolescence of the older radars.

*Note from the Editor:* The surface-to-air-weapons upgrade programme of the existing systems appears to have run into rough weather, necessitating perhaps outright replacement of the obsolete equipment.

**SP's:** *Ballistic/cruise missile threat, especially from our neighbourhood, has acquired distinct possibilities. Is the IAF looking at acquiring anti-ballistic missile (ABM) and anti-cruise missile capabilities?*

**CAS:** ABM capability is desirable, but comes with attendant cost. Cost-benefit analysis and constant review of its requirement is conducted periodically along with available options. A system most appropriate for our requirements will be considered at the national level.

**SP's:** *The IAF was to reportedly acquire 80 helicopters of Mi-17 class to augment its rotary wing capability. What is the status of this project?*

**CAS:** The project for acquiring 80 Medium Lift Helicopters to augment IAF's heli-lift capability is progressing satisfactorily. The Defence Procurement Board has given its 'go ahead' in July 2007. Delivery of additional helicopters will commence in the next financial year.

*Note from the Editor:* The IAF's requirement of 150 light helicopters to replace the Chetak/Cheetahs has been clubbed with the army's after the latter's deal to acquire 197 helicopters from Eurocopter failed. The new tender would be for 317 helicopters.

**SP's:** *What are the IAF's plans to further augment its UAV fleet?*

**CAS:** The UAV is a potent force-multiplier with great capabilities, which can enhance our op capability and preparedness. IAF has been the pioneer in operational exploitation of UAVs and is integrating them with a variety of weapon platforms. In response to the current and emerging requirements, the UAVs are being employed on a variety of missions. •

*For full interview, read SP's Military Yearbook 2007-2008*

by Air Marshal (Retd) V.K. Bhatia

# Revving up Radar Count

India's Union War Book has placed the country's air defence responsibility squarely on the shoulders of the Indian Air Force (IAF). The IAF, in turn, has given the highest priority to ensure inviolability of the Indian 'Air Space' by continuously striving to build a strong air defence comprising of fighter interceptors and the corresponding ground environment. The 1960s saw the induction of fighter interceptors, surface-to-air missiles (SAM) and AD radars with the induction of MiG-21 aircraft and Dvina SA-2 SAM system. Star Sapphire high-powered radars from the US gave the necessary boost to the radar environment in the 1960s followed by French radars in the form of PSM-33, TRS-2215 and THD-1955 in the 1970s. The low looking radar capability was generated with the induction of ST-68U/UM and creative integration of SAM systems' acquisition radars and the base SRE radars. Later, these were supplemented by indigenous Indra I&II radars. The networking of these radars was carried out with the Tropo-scatter communication system but it was not networking in the true sense, which required data fusion. Now, after a gap of about two decades, with the induction of aerostat radars and, the AWACS in the near future, the IAF could look forward to acquiring network-enabled surveillance required for a modern battlefield.

Aerostats and the AWACS aircraft, however, can largely be used only in the supplementary roles to the ground-based radar network which provide the backbone of an air defence system. In this context, due to severe financial constraints of the early 1990s, the air defence radar capability of the IAF instead of being augmented actually fell in a trap of obsolescence and negative growth. The Star Sapphire radars had to be retired having outlived their useful life in service. The French high-powered THD-

1955 radars have gone through some limited upgrades to improve their functioning and maintainability but still suffer from ageing. The same is the case with the medium-powered PSM-33 and the TRS-2215 radars which need augmentation. As far as the low level coverage is concerned, the present capability can only look after the border areas adjoining India's western neighbour.

Three AWACS aircraft which use the Russian IL-76 airframe and the Israeli Phalcon radar systems will soon be acquired by the IAF which also plans to add to the two (already in service) aerostat systems from Israel. But it is in the field of ground based radars that the IAF is actively scouting for the complete range of high power, medium power and LLTR (Low Level Transportable Radars) to fill the existing voids and to further augment capabilities. In addition, the IAF is also acquiring new base SRE radars to replace its present ageing inventory which can be dove-tailed into the air defence network system. The IAF is also focussed on developing/acquiring an Integrated Air Command and Control System for network enabled air defence operations. While this is a step in the right direction, the task is riddled with complexities when data from the radars of different technology and age need to be fused. The task will be even more formidable when the data from radars of different civil and military agencies has to be integrated to provide a composite picture to the decision makers at various levels. The IAF will however, have to find the right answers to ensure a seamless and properly networked air defence system to safeguard the country's airspace. For this, it needs the necessary governmental support and funding to be able to execute its upgrade and modernisation programmes. •



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## Unmanned & Unparalleled

Continued from page 13

- Can carry out of remote sensing functions with the help of electromagnetic spectrum sensors, biological sensors, and chemical sensors. Biological sensors are capable of detecting the airborne presence of various microorganisms and other biological factors. Chemical sensors use laser spectroscopy to analyze the concentrations of each element in the air.

### A look at some UAVs

- **High Altitude Endurance UAV (Global Hawk):** Intended for missions requiring long-range deployment and wide-area surveillance or long sensor dwell over the target area, and manned by the US Air Force. It has a cruising speed of 404 mph (650 km/h), endurance of 36 hours and service ceiling of 65,000 ft (20,000 m). Northrop Grumman is the prime contractor.

- **Medium Altitude Endurance UAV Predator B:** The turboprop-powered Predator B, designated MQ-9B is manned by the US Air Force and referred to as the hunter-killer, flies faster, higher and carries more weapons than the Predator. It has a maximum air-speed of 260 kts and a cruising speed for maximum endurance of 150-170 kts. Predator B can be used as an unarmed combat aerial vehicle (UCAV) and can fire AGM-114 Hellfire II laser-guided air-to-surface missile to attack stationary ground targets. General Atomics is the prime contractor.

- **MQ-5B Hunter:** The US Army's MQ-5B is powered by two 'heavy fuel' diesel engines of Northrop Grumman, which allows it to operate at higher altitudes of 6,100 m (20,000 ft) with an endurance of 15 hours. The primary payload on the RQ-5A is the Multi-Mission Optronic Payload, developed by IAI Tamam, which includes television and Forward Looking Infrared to provide day / night surveillance capability. A communications relay payload extends VHF/UHF communications beyond line of sight. Electronic countermeasures payloads include communications warning receiver, communications jammer and radar jammer supplied by Northrop Grumman. The extended centre wing has two external hard points capable of carrying weapons such as the Northrop Grumman Viper Strike laser-guided munition.

- **RQ-11 Raven:** The AeroVironment's RQ-11 Raven is a remote-controlled miniature unmanned aerial vehicle used by the US Army, Marine Corps and Special Forces Command. It is launched by hand and powered by an electric motor. The plane can fly up to 6.2 miles (10 km) up to altitudes of 1,000 feet (305 m) AGL, and 15,000 feet MSL, at flying speed of 28-60 mph. It has a weight of 4.2 lbs and endurance of 80 minutes.

- **RQ-7 Shadow 200 Tactical UAV:** The Tactical Unmanned Aerial Vehicle (TUAV) system is designed as a ground manoeuvre commander's primary day/night reconnaissance, surveillance, target acquisition, and battle damage assessment system which is small and lightweight. The payload has a commercially available electro-optic and infrared camera, and communications equipment for command and control and imagery dissemination. Onboard global positioning system instrumentation provides navigation information. Shadow is intended to provide coverage of a brigade area of interest for up to four hours, at 50 kilometers from the launch and recovery site. The maximum range is 125 kilometers (limited by data link capability), and operations are generally conducted from 8,000 to 10,000 feet above ground level during the day and 6,000 to 8,000 feet above ground level at night.

### Vertical take off & landing UAVs

VTUAVs are ideally suited for operating from the deck as no special arrangements have to be made for take off or landing. Some examples are covered here.

- **Northrop Grumman's RQ/MQ-8 Fire Scout:** RQ-8 Fire Scout :The US Navy had withdrawn from the RQ-6 Outrider programme in 1998 and was looking for a VTUAV to replace the RQ-2 Pioneer. After a careful survey Northrop Grumman's Fire Scout was selected in February 2000 and a contract for one system was given. The first production model flew in May 2002. The RQ-8A is based on the Schweizer Model 330SP manned light helicopter. It is powered by a derated Rolls-Royce/Alison 250-C20W turboshaft engine with three-bladed rotors which can be folded for stowage. The Fire Scout is equipped with a GPS-based navigation system for autonomous operations, and the ground control station can control three UAVs simultaneously. The line-of-sight range of the Ku-Band Tactical Common Datalink is about 280 km. The payload for the reconnaissance and targeting mission is an integrated Northrop Grumman Electro-Optical/Infrared/Laser Designator & Rangefinder system.

- **MQ-8B:** Northrop Grumman had also proposed an improved version called Sea Scout (MQ-8B) which would include a four-blade rotor for increased payload and mission duration, and carry precision-guided air-to-surface missiles. In January 2004 the MQ-8B was selected by the US Army for its Future Combat System Unmanned Aerial System requirement. The US Navy has also selected the MQ-8B to support its Littoral Combat Ship vessels. •

## TIMEOUT - OUTSIDE DEFEXPO '08

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**Shila Language & Consultancy,** SD 216, Pitampura; Ph: 2731-2729, 2731-5024



## COMPANY BRIEFS

### Raytheon teams up with SAIC

Raytheon Technical Services Company LLC (RTSC), a subsidiary of Raytheon Company, has signed a teaming agreement with Science Applications International Corporation (SAIC) to pursue the Federal Aviation Administration's Air Traffic Control Optimum Training Solution programme. ATCOTS is the FAA's programme to procure a performance-based solution for training of new and current air traffic controllers.

### Italy awards order for 4 FREMM frigates

The Italian Ministry of Defence has signed a contract for the second batch of the FREMM multi-mission frigate programme it is developing jointly with France. No value has been provided for this contract.

### Boeing ready with MMRCA RFP

Boeing is totally prepared with the MMRCA RFP for IAF's requirement of 126 aircraft due to be submitted to the Indian government two weeks from now. Boeing will be in position to meet all requirements of the RFP, including time schedules, transfer of technology and licence production. If selected, Boeing plans to provide the aircraft according to the following programme:

- First 18 aircraft will be built at Boeing's St. Louis facility in the US. With the first aircraft to be delivered within 36 months of the contract and the 18th within 48 months.
- Phase 1: Boeing will provide SKD kits to HAL for assembly in India.
- Phase 2: Boeing will provide CKD kits for further assembly in India.
- Phase 3: Boeing will transfer the technology for fabrication of components and spare parts in India.

—by Air Marshal (Retd) V.K. Bhatia

## P8I Maritime Surveillance Aircraft from Boeing

Boeing is in the race for the Indian Navy tender for Maritime Surveillance aircraft, confirmed Richard W. Buck, Programme Manager, International Operations & New Product Development, Boeing. The platform is the Boeing Next-Generation 737-700 featuring 21st century avionics, navigation equipment and flight deck. High technology has ensured the aircraft requires minimal downtime for maintenance. The 737 series is one of the most popular and reliable jet aircraft in the world. Its popularity has resulted in a worldwide base of suppliers, parts and support equipment.

The Multi-role Electronically Scanned Array (MESA) radar is the critical sensor aboard the 737 AEW&C. The steerable beam, L-band electronically scanned array is designed to provide optimal performance in range, tracking, and accuracy. The radar is able to track airborne and maritime targets simultaneously and can help the mission crew direct the control of fighter aircraft while continuously scanning the operational area. The so-called 'top hat' portion of the MESA radar provides a practical solution for fore and aft coverage while maintaining the low drag profile of the dorsal array system. This allows the system to be installed on the mid-size 737-700 platform without significant impact on aircraft performance. Another innovation is the integrated Identification Friend or Foe sharing of the primary radar arrays to reduce weight, improve reliability, and simplify target correlation.

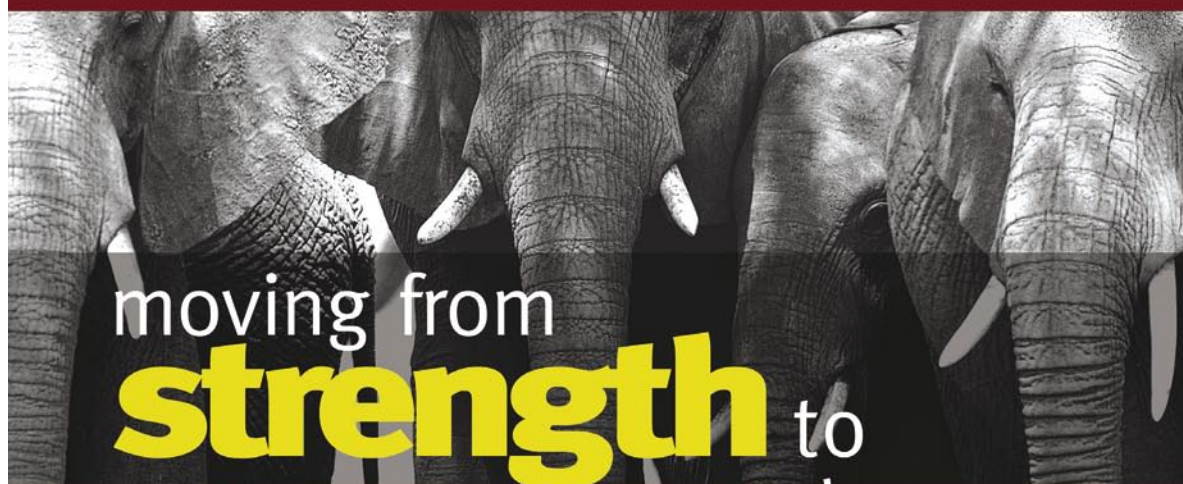
Over 1,200 hours of wind tunnel testing have demonstrated the compatibility of the aircraft and the radar.

—by Air Marshal (Retd) B.K. Pandey



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AVRORA CORPORATION S&P	11	10 & 17
AZIMUTH TECHNOLOGIES LTD	11	1-4 & 6
BAE SYSTEMS	10	1&1A
BARRET FIRE ARMS MANUFACTURING INC, USA	14	14.2
BASANT AEROSPACE PVT LTD	18 MEZ. FLR	30-30A
BELOMA	18 MEZ. FLR	33
BELTECH EXPORT, BELARUS	18 MEZ. FLR	33
BEML LTD.	OUTDOOR	OD-5&6
BENGAL WATERPROOF LIMITED	18 MEZ. FLR	31
BERGEN ELECTRONICS	18 GF	E27
BERTIN	12	12.214
BETH-EI ZIKHRON YAAKOV INDUSTRIES LTD	11	1-4 & 6
BHARAT DYNAMICS LIMITED	18 GF	59
BHARAT ELECTRONICS LTD	11	8
BOEING, USA	14	14.114
BONN-HUNGARY KFT.(BONN-HUNGARY LTD.)	18 GF	56
BRUKER DALTONICS LTD	10	1&1A
BUMAR, POLAND	18 MEZ. FLR	35
BUTLER INTERNATIONAL	14	14.12
CADES DIGITECH P LTD	18 MEZ. FLR	19-20
CALZONI	11	11-14 & 16
CAPRO	18 GF	64-A

NAME OF THE COMPANY	HALL NO.	BOOTH NO.
CARINEX KFT. (CARINEX LTD.)	18 GF	56
CARL ZEISS OPTRONICS	12-A	14,15 & 25
CASCADE MICROTECH, INC.	14	110A
CBS TECHNOLOGIES	18 GF	E14
CCO CREATIVE CONSULTING GMBH, GERMANY	12-A	14,15 &25
CENTRUM ELECTRONICS LTD.	18 GF	71-72
CESKA LETECKA SERVISNI A.S	18 MEZ. FLR	39
CHANAKYA AEROSPACE, DEFENCE & MARI- TIME REVIEW	18 MEZ. FLR	34-D
CHEMRING GROUP PLC	10	1&1A
CMC LTD	12-A	3
CMT DYNAMICS, UK	18 MEZ. FLR	34-C
CNIM	12	12.214
COBHAM PLC	10	1&1A
COLT DEFENSE, USA	14	14.200
CONCEPT SHAPERS & ELECTRONICS P LTD	12-A	23
CONNEKT ELECTRONICS P LTD	11	7A
CONTROP PRECISION TECHNOLOGIES LTD	11	1-4 & 6
CORAL TELECOM LIMITED	18 GF	42
CRIMSON TRACE CORP, USA	18 MEZ. FLR	2
DASS HITACHI LTD	OUTDOOR	OD-2
DATA PATTERNS (INDIA) PRIVATE LIMITED	12-A	21&21A
DCI/DESCO	12	12.203
DCI/NAVFCO	12	12.203
DCNS	12	12.202
DEFENCE EXPORT SERVICE ORGANISATION -UNITED KINGDOM MINISTRY OF DEFENCE	10	1&1A
DEFENCE MANUFACTURERS ASSOCIATION, U.K	10	1&1A
DEFENCE RESEARCH DEVELOPMENT OR- GANISATION	OUTDOOR	OD-4
DEFENSE RESEARCH DEVELOPMENT OR- GANISATION	8-11	
DEFENSE RESEARCH DEVELOPMENT OR- GANISATION	10	2 &2A
DEFENSEWORLD.NET	18 MEZ. FLR	33-B
DESO MEETING ROOM	10	1&1A
DGA/DDI	12	12.215
DIEHL VA SYSTEMS STIFTUNG & CO.KG	12-A	14,15 &25
DIRECTORATE GENERAL RESETTLEMENT	12-A	21-B
DISASTER MANAGEMENT SYSTEMS PVT. LTD.,(A DIVISION OF YOUNG INDIA FILMS)	18 MEZ. FLR	33-A
DISTANT RADIOCOMMUNICATION SCIEN- TIFIC RESEARCH	11	10 & 17
DOLGOPRUDNY RESEARCH & PRODUCTION ENTERPRISE JSC	11	10 & 17
DOMO LTD / ARKARA ENGG PVT LTD	11	19-C
DSM DYNEEMA, THE NETHERLANDS	18 GF	67-69
DSR KFT. (DSR LTD.)	18 GF	56
DUNMORE CORPORATION	14	110A
DYNALOG INDIA LIMITED	18 GF	3-5
EADS DEUTSCHLAND GMBH, EUROPE	12	3
EADS, EUROPE	OUTDOOR	OD-1
ECA	12	12.206
ECIL	18 GF	57
EDICONSULT INTERNAZIONALE, ITALY	11	11-14 & 16
EDS TECHNOLOGIES PVT. LTD.	18 GF	32
EFFTRONICS SYSTEMS PVT. LTD.	18 GF	E10
EICHER ENGINEER SOLUTIONS	18 GF	61-D&E
ELBIT SYSTEMS LTD	11	1-4 & 6
ELECTRONAVAL	12	12.206
ELECTROSOLVE	18 GF	E12
ELEKTRONIK LAB	11	9-A
ELETTRONICA	11	11-14 & 16
ELGI EQUIPMENTS LTD.	18 GF	94
ELKOSTA SECURITY SYSTEMS	18 GF	33A&D
ELSAG DATAMAT	11	11-14 & 16
EMGEPRON, BRAZIL	18 GF	54
ENERTECH GROUP OF COMPANIES	18 GF	6
ETIENNE LACROIX	12	12.214
EURENCO	12	12.204
EUROCOPTER, FRANCE	12	3
EUROFIGHTER GMBH, GERMANY	12	3
EURONAVAL	12	12.215
EUROSATORY	12	12.214
EUROTORP	12	12.211
EVOLUTION,WIRKS PTE LTD, SINGAPORE	14	14.14B
EXPLOSION A.S	18 MEZ. FLR	39
FEDEGARI AUTOCLAVI	11	11-14 & 16
FINCANTIERI	11	11-14 & 16
FINMECCANICA	11	11-14 & 16
FISCHER CONNECTORS LTD	10	1&1A

NAME OF THE COMPANY	HALL NO.	BOOTH NO.
FLIR GOVERNMENT SYSTEMS, USA	14	14.101
FLÜ (DEVELOPMENT AND LOGISTICS AGENCY)	18 GF	56
FORCE	14	14.3
FTE CENZIN CO. LTD.	18 MEZ. FLR	84-85
FUTURA AUTOMATION PVT LTD	11	18
GALILEO AVIONICA	11	11-14 & 16
GAMMA ZRT. (GAMMA EXCLUSIVE GROUP)	18 GF	56
GARDEN REACH SHIPBUILDERS & ENGI- NEERS LTD	14	14.16
GE AVIATION (GENERAL ELECTRIC), USA	14	14.304
GE SECURITY	14	14.6
GENERAL DYNAMICS, USA	14	14.302
GENESIS EW LTD	11	1-4 & 6
GICAN	12	12.215
GICAT	12	12.214
GOENKA ENGG & INDUSTRIAL PVT LTD.	18 GF	E8
GOODRICH	12	12.208
GRANIT-ELECTRON CONCERN JOINT STOCK COMPANY	11	10 & 17
GRINTEK EWATION, SOUTH AFRICA	18 GF	8
GRINTEX INDIA LIMITED	18 GF	22
GROZ ENGINEERING TOOLS (P) LTD	18 MEZ. FLR	34-E
HALL 14 OUT DOOR		
HAMMER LASER INSTRUMENTS INDIA PVT LTD	14	14.201
HECKLER & KOCH GMBH	12-A	14,15 &25
HIAB, UK	18 MEZ. FLR	8-10
HINDUSTAN AERONAUTICS LIMITED	18 GF	58
HM ARZENÁL ZRT. (MOD ARZELNÁL EXCLU- SIVE GROUP)	18 GF	56
HONEYWELL, USA	14	14.103
HR SMITH GROUP OF COMPANIES,(TECHMECH) UK	18 GF	60-A
HYPERTAC (DVN OF JOHN CRANE SEALINGS INDIA SYSTEMS)	18 MEZ. FLR	88
HYPRECISION HYDRAULIK	18 GF	E11
IAI ISRAEL AEROSPACE INDUSTRIES LTD	11	1-4 & 6
ICE- ISTITUTO PER IL COMMERCIO ESTERO	11	11-14 & 16
ICOMM TELE LTD.	18 GF	50
ICX TECH, USA	14	14.104
IMI ISREAL MILITARY INDUSTRIES LTD	11	1-4 & 6
INDIA STRATEGIC	14	14.203
INDIAN ARMOUR	18 GF	E23&24
INDIAN DEFENCE REVIEW	18 GF	61-1
INDIAN REGISTER OF SHIPPING	18 MEZ. FLR	11
INDRA, SPAIN	18 MEZ. FLR	4-5
INPP	12	12.207
INTEGRATED DIGITAL SYSTEMS	18 GF	E34
INTEL DESIGN SYSTEMS (INDIA) PVT. LTD.	18 GF	E-3
TROBOT INDIA PVT LTD	18 MEZ. FLR	33-D
ISREAL WEAPON INDUSTRIES (IWI) LTD	11	1-4 & 6
IT GLOBAL INC.	14	110A
ITI LIMITED	18 GF	31
ITL OPTRONICS LTD	11	1-4 & 6
ITT CORPORATION, USA	14	14.210'
IZHMASH CONCERN JSC	11	10 & 17
J.P. SAUER & SOHN GMBH, GERMANY	18 MEZ. FLR	2
JANES INFORMATION GROUP, SINGAPORE	18 MEZ. FLR	33-C
JCB INDIA LTD	14	14.9
JOHNSON CONTROLS (INDIA) PVT LTD	18 MEZ. FLR	43
JOHNSON MACHINERIES LTD	12-A	2
JOSEPH LESLIE DRAGER MANUFACTURING PVT LTD	18 MEZ. FLR	86-87
JUPITER STRATEGIC TECHNOLOGIES PVT LTD	18 MEZ. FLR	73
KAERCHER FUTURETECH GMBH, GERMANY	12-A	16
KAZAN GUNPOWDER PLANT	11	10 & 17
KBP INSTRUMENT DESIGN BUREAU	11	10 & 17
KERMEL INDIA	18 MEZ. FLR	55
KIA MOTORS CORP	18 MEZ. FLR	48
KIMOHA ENTREPRENEURS LTD, UAE	18 MEZ. FLR	69
KINTEX, BULGARIA	11	7
KIRLOSKAR PROPRIETARY LTD	12	4
KOMMLABS DEZIGN PVT. LTD.	18 GF	34
KONSTRUKTA - INDUSTRY A.S	18 MEZ. FLR	39
KOREAN DEFENSE INDUSTRY ASSOCIATION,KOREA	18 MEZ. FLR	46
KRASNY MARINE SERVICES PVT LTD	14	14.14A
KRAUSS-MAFFEI WEGMANN GMBH & CO KG	12-A	14,15 &25
KVH INDUSTRIES INC, USA	14	14.120
L-3 COMMUNICATION EOTECH, INC, USA	14	14.102
LAMBDA MICROWAVES PVT. LTD.	18 GF	E35&36
LANDROVER, UK	12-A	30
LARSEN & TOUBRO LTD	12-A	1
LITEF GMBH	12-A	14,15 &25
LOCKHEED MARTIN CORPORATION, USA	14	14.301
LOTUS MACHINES (P) LIMITED	18 GF	E25
LPS BOSSARD PVT. LTD.	18 GF	63

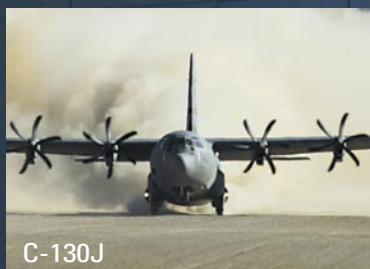


NAME OF THE COMPANY	HALL NO.	BOOTH NO.
LUCAS TVS LIMITED	18 GF	60-I
M.O.D	11	11-14 & 16
MACHINERY SALES CORPORATION	18 GF	52
MACMET TECHNOLOGIES LTD	11	5
MACTAGGART SCOTT & CO LTD	10	18&1A
MAGNUM (CHOGORI)	18 GF	61-C
MAGYAR VÉDELMIIPARI SZÖVETSÉG (HUNGARIAN INDUSTRIAL DEFENSIVE ALLIANCE).	18 GF	56
MAHINDRA DEFENCE SYSTEMS	09	6
MARLOG MARINE LOGISTIC	12-A	14,15 & 25
MASPACK LTD	14	14.14C
MATCON		60-G
MAURY MICROWAVE CORPORATION	14	110A
MBDA	12	12.201
MEGGITT DEFENSE SYSTEMS, USA	14	14.118
MEL SYSTEMS & SERVICES LTD.	18 GF	E1&2
MEMORY ELECTRONICS PVT. LTD.	18 GF	19-21
MEPROLIGHT (1990) LTD	11	1-4 & 6
MERLINHAWK ENGINEERING PVT LTD	18 MEZ. FLR	66
MESSAGE TIME A.S, CZECH REPUBLIC	18 MEZ. FLR	39
META COPPER & ALLOY LTD.	14	14.202
METALTECH MOTOR BODIES PVT LTD	OUTDOOR	OD-3
MIC OFFICE	14	14.106
MICROTURBO	12	12.212
MIDIVISANA LTD	18 MEZ. FLR	33
MILITARY-INDUSTRIAL COMPANY LLC	11	10 & 17
MINISTRY OF DEFENCE, REPUBLIC OF HUNGARY, HUNGARY	18 GF	56
MINISTRY OF INDUSTRY AND TRADE OF THE CZECH REPUBLIC	18 MEZ. FLR	39
MISHRA DHATU NIGAM LIMITED	18 GF	55
MISTRAL SOLUTIONS PVT LTD.	18 GF	61
MKU PRIVATE LIMITED	12-A	19
MOH-9 ARMOUR CERAMICS, SOUTH AFRICA	18 GF	7
MOOG MOTION CONTROLS PVT. LTD.	18 GF	53
MOTLEY EXIM CO	12-A	17
MOTOR SICH JSC (NEXPO)	18 MEZ. FLR	60
MTU FRIEDRICHSHAFEN GMBH	12-A	14,15 & 25
MUSTHANE	12	12.216
NACRE AS, NORWAY	18 MEZ. FLR	2
NATIONAL INSTRUMENT	18 GF	61-J
NATRAJ PUBLISHERS	18 MEZ. FLR	47
NAVAL SHIPYARD GDYNIA S.A	18 MEZ. FLR	84-85
NAVANTIA, SPAIN	18 GF	2
NDMA	18 GF	60-D&E
NELCO LIMITED	12-A	3
NEW NOGA LIGHT (2000) LTD	11	1-4 & 6
NEXTER	12	12.210
NORTHROP GRUMMAN CORPORATION, USA	14	14.303
NOVATOR EXPERIMENTAL MACHINE DESIGN BUREAU	11	10 & 17
NOVOSIBIRSK CARTRIDGE PLANT	11	10 & 17
NUDELMAN PRECISION ENGINEERING BUREAU	11	10 & 17
OASIS WEAR TECH INDUSTRIES LLC, UAE	12-A	21-C
OMNIPOL A.S	18 MEZ. FLR	39
OPTIWAWE PHOTONICS LIMITED	18 GF	60-B
ORDNANCE FACTORY BOARD	12-A	20
OTO MELARA	11	11-14 & 16
OXLEY GROUP LTD, UK	11	19
PALADION NETWORKS	18 GF	36
PALL	12	12.208
PAN INTELLECOM LTD.	18 GF	103
PASSAPONTI	11	11-14 & 16
PAUSLTRA	12	12.215
PEARSON ENGINEERING	10	18&1A
PELENG JSC	18 MEZ. FLR	33
PERMALI WALLACE PRIVATE LIMITED	18 GF	E21
PHASE MATRIX INC.	14	110A
PHOTONIS NETHERLANDS B.V, THE NETHERLANDS	18 MEZ. FLR	14
PLANSEE - CIME BOCUZE, FRANCE	18 MEZ. FLR	77
PLASAN SASA LTD	11	1-4 & 6
POLICKSKE STROJIRNY A.S	18 MEZ. FLR	39
POLISH CHAMBER OF NATIONAL DEFENCE MANUFACTURERS, POLISH	18 MEZ. FLR	30D
POLISH CHAMBER OF NATIONAL DEFENCE MANUFACTURERS, POLISH	18 MEZ. FLR	30E
POMPE GARBARINO	11	11-14 & 16
PRECISION ELECTRONICS LTD	09	2
PRECISION OPERATIONS SYSTEM (INDIA) PVT. LTD.	18 GF	E28,29,30
PRINCETON MICROWAVE TECHNOLOGY INC.	14	110A

NAME OF THE COMPANY	HALL NO.	BOOTH NO.
PROENGIN INDIA	18 MEZ. FLR	70
PRONAL	12	12.208
PULSE E TECHNOLOGIES PVT LTD	18 MEZ. FLR	18
PZL-HYDRAL S.A.	18 MEZ. FLR	84-85
QMAX TEST TECHNOLOGIE	18 GF	E18-19
R K & SONS	14	14.204
RADIALL PROTECTRON (P) LTD	18 MEZ. FLR	53
RADIOZAVOD INCORPORATED STATE COMPANY	11	10 & 17
RADMOR S.A.	18 MEZ. FLR	84-85
RAFAEL ADVANCED DEFENSE SYSTEMS LTD	11	1-4 & 6
RAJASTHAN METAL SMELTING CO.	18 GF	61-A
RAYTHEON COMPANY, USA	14	14.206
RB COMTEC PVT. LTD.	18 GF	30
RDI COMMUNICATIONS (PTY) LTD, SOUTH AFRICA	18 GF	9
REEBOK INDIA COMPANY	18 GF	60-F
RELLUMIX	12	12.215
RHEINMETALL AG	12-A	14,15 & 25
RICOR CRYOGENIC & VACCUM SYSTEMS	11	1-4 & 6
RINA	11	11-14 & 16
RIPPLE EFFECT WEAPON SYSTEMS PTY LTD, SOUTH AFRICA	18 GF	11
ROCHEM SEPARATION SYSTEMS (I) PVT LTD.	18 GF	101
ROHDE & SCHWARZ GMBH & CO KG	12-A	14,15 & 25
ROLTA INDIA LIMITED	18 GF	1
ROOTS MULTICLEAN	18 GF	99
ROSOBORONEXPORT STATE CORPORATION, RUSSIA	11	10 & 17
ROSOBORONSERVICE (INDIA) LIMITED	11	10 & 17
ROTMOTION LLC, USA	OUTDOOR	14 OD
ROXEL	12	12.204
ROXTEC INDIA PVT. LTD.	18 GF	24
RUBIN STATE OWNED ENTERPRISE "CENTRAL DESIGN BUREAU FOR	11	10 & 17
RUE <<DB RADAR>>	18 MEZ. FLR	33
RUSRE<<LUCH>>	18 MEZ. FLR	33
S M CREATIVE ELECTRONICS LTD.	18 GF	E 16
SAAB, SWEDEN	11	15
SAARC TOOL TECH PVT. LTD.	18 GF	64-E
SAFRAN	12	12.212
SAFT	12	12.209
SAGAX KFT. (SAGAX LTD.)	18 GF	56
SAGEM DEFENSE SECURITE	12	12.212
SAINT GOBAIN CERAMIC	12	12.215
SAINT GOBAIN SULLY	12	12.215
SAMSUNG THALES CO LTD	18 MEZ. FLR	47
SAMTEL COLUR LTD	12-A	18
SAN SWISS ARMS AG, SWITZERLAND	18 MEZ. FLR	2
SANDEEP METALCRAFT PVT LTD	18 MEZ. FLR	12
SAP MEDIA WORLDWIDE	14	14.5
SAP MEDIA WORLDWIDE PVT LTD	12-A	3A
SATCON POWER CONTROLS LTD.	18 GF	E22
SCD SEMICONDUCTOR DEVICES, ISRAEL	18 MEZ. FLR	83
SCHLEIFRING GMBH	12-A	14,15 & 25
SDS ELECTRONICS PVT LTD	14	14.17-19
SDV	12	12.205
SECURITY SHOPPE (INDIA) PVT. LTD.	18 GF	60-J
SELEX SENSORS AND AIRBORNE SYSTEMS	11	11-14 & 16
SELEX SISTEMI INTEGRATI	11	11-14 & 16
SERO KFT. (SERO LTD.)	18 GF	56
SESM	12	12.214
SEVERNOYE DESIGN BUREAU FSUE, ST. PETERSBURG	11	10 & 17
SHIVA INDUSTRIES	18 MEZ. FLR	16
SIBAT - DEFENCE EXPORT & DEFENSE COOPERATION, ISRAEL	11	1-4 & 6
SIEMENS AG, GERMANY	18 GF	33-C
SIKORSKY AIRCRAFT, USA	14	14.401
SIMRAO OPTRONICS ASA, NORWAY	18 MEZ. FLR	82
SINGAPORE TECHNOLOGIES KINETIC, SINGAPORE	11	16A
SIREHNA	12	12.202
SKL INDIA PVT LTD	12-A	16
SM GROUP	14	14.22
SMITHS DETECTION	10	18&1A
SOFEMA	12	12.208
SOFRADIR	12	12.213
SOGENA, FRANCE	12	12.201 TO 12.217
SOLTAM SYSTEMS LTD	11	1-4 & 6
SOUTHWEST MICROWAVE, INC.	14	110A
SP GUIDE PUBLICATIONS PRIVATE LTD	18 MEZ. FLR	40
SPECK SYSTEMS LTD	11	20
SPECK SYSTEMS LTD	OUTDOOR	OD-1

NAME OF THE COMPANY	HALL NO.	BOOTH NO.
SPETSTECHNOEXPORT COMPANY, UKRAINE	18 MEZ. FLR	60
SPLAV FEDERAL STATE UNITARY ENTERPRISE STATE RESEARCH AND	11	10 & 17
SRG TECHNO (P) LTD	18 MEZ. FLR	2
SRITECH ELECTRONICS & SYSTEMS PVT. LTD.	18 GF	18
STARWIRE INDIA LTD	12-A	24
STRONGFIELD TECHNOLOGIES LTD	10	1&1A
SURE SAFETY SOLUTIONS PVT. LTD	18 GF	46-47
SYSTEM & EQUIPMENT MAINTAINES CO.	18 GF	E9
SYSTEM CONTROLS	18 GF	E-7
SYSTEMS SUNLIGHT S.A, GREECE	12-A	26
TAMBOV GUNPOWDER PLANT FEDERAL FISCAL ENTERPRISE	11	10 & 17
TASER INTERNATIONAL (NASDAQ: TASR) USA	18 MEZ. FLR	2
TATA ADVANCED MATERIALS LIMITED	12-A	3
TATA ADVANCED SYSTEMS LTD	12-A	3
TATA BP SOLAR LIMITED	12-A	3
TATA COMMUNICATIONS LTD	12-A	3
TATA CONSULTANCY SERVICES LIMITED	12-A	3
TATA INDUSTRIAL SERVICES LTD	12-A	3
TATA MOTORS LTD	12-A	3
TATA POWER LIMITED - STRATEGIC ELECTRONICS DIVISION	12-A	3
TATA SONS LTD	12-A	3
TATA TECHNOLOGIES LTD (INCAT)	12-A	3
TATA TELESERVICES LIMITED	12-A	3
TDI ISRAEL, ISRAEL	18 MEZ. FLR	2
TECHNOPOL INTERNATIONAL, A.S, , SLOVAKIA	11	9
TEIJIN TWARON	12-A	14,15 & 25
TEKTRONIX INDIA PVT LTD.	18 GF	61-F
TELCON	12-A	3
TELLUMAT PTY LTD, SOUTH AFRICA	18 GF	10
TENCATE ADVANCED ARMOUR ROSHIELD A/S, DENMARK	18 MEZ. FLR	22
TENCATE ADVANCED COMPOSITES, USA INC.	14	110A
TEXPLUS FIBRES PVT. LTD.	18 GF	60-C
TEXTAS INSTITUTE, USA	14	14.108
THALES	12	12.217
THALES TRAINING & SIMULATION LIMITED, FRANCE	OUTDOOR	14 01-OD-2
TIP TOP GENERAL AGENCIES PVT. LTD.	11	19 B
TITAN INDUSTRIES LIMITED	12-A	3
TRIDENT INFOSOL PVT. LTD.	18 GF	27
TRIJICON INC, AUSTRALIA	18 MEZ. FLR	2
TSNIITOCHEMASH (CENTRAL SCIENTIFIC-RESEARCH INSTITUTE OF	11	10 & 17
TTC TELEKOMUNIKACE, S.R.O	18 MEZ. FLR	39
TULA CARTRIDGE WORKS, JSC	11	10 & 17
TULIP IT SERVICE LTD	09	5
TURBOMECA	12	12.212
TYCO ELECTRONICS CORPORATION	18 MEZ. FLR	71-72
TYPHOON RESEARCH AND PRODUCTION ENTERPRISE JSC	11	10 & 17
U S DEPT. OF DEFENCE (US ARMY) USA	14	14.111
U.S. ORDNANCE, USA	14	14.116-117
ULMER	12	12.208
ULTRA ELECTRONICS	10	18&1A
ULTRA LIFE BATTERIES, USA	18 MEZ. FLR	81
ULYANOVSK CARTRIDGE WORKS OPEN-END JOINT-STOCK COMPANY	11	10 & 17
UNDERSEA DEFENCE TECHNOLOGY, UK	18 MEZ. FLR	42
UNEX POWER POINT P LTD	12-A	21-D
UNIVERSAL FLEXIBLES PRIVATE LIMITED	18 GF	60
VAYU AEROSPACE & DEFENCE REVIEW	14	14.12A
VECTRA	12	1
VECTRONIX (GIC)	18 MEZ. FLR	6
VEM TECHNOLOGIES P LTD	18 MEZ. FLR	23
VICTORINOX INDIA P LTD	18 MEZ. FLR	61
VIJAY SABRE SAFETY P LTD	18 MEZ. FLR	74
VINVISH TECHNOLOGY	18 GF	35
VOICE OF BOARD, USA	14	14.110'
VOICECOM TECHNOLOGIES PVT LTD.	18 GF	28
VOLVO PENTA	18 MEZ. FLR	27-28
VS CONSULTANTS	18 MEZ. FLR	54
W.L. GORE & ASSOCIATES	14	110A
WHITEHEAD ALENIA SISTEMI SUBACQUEI	11	11-14& 16
WSK "PZL-SWIDNIK" S.A.	18 MEZ. FLR	84-85
WSK PZL-KALISZ S.A.	18 MEZ. FLR	84-85
YENTREK INTERNATIONAL	18 GF	E 15
YEONHAB PRECISION CO LTD	18 MEZ. FLR	46
YUGOIMPORT, SERBIA	18 MEZ. FLR	48,49,50
ZAPORozHYE MACHINE-BUILDING DESIGN BUREAU PROGRESS STATE	18 MEZ. FLR	60
ZEN TECHNOLOGIES LTD	12-A	22
ZETATEK INDUSTRIES LTD.	18 GF	E31,32,33
ZVEZDA, JSC	11	10 & 17





# how

**BETWEEN PARTNERSHIPS PROMISED AND PARTNERSHIPS ACHIEVED,  
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